THE

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THE

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THE SWISS REUNION AND ITS LESSONS.

Now that the visit of the Institution of Electrical Engineers to the industrial districts of Switzerland has taken its place amongst the proceedings of the past, the time has come to consider what we have learnt as the result of our investigations. Various questions arise of great interest and importance. We will select for consideration the following :—Are we falling behind in the march of electrical engineering progress? If so, what are the causes of our backwardness, and how can they be removed?

We are immediately struck by the fact that the conditions prevailing in this country are not comparable with those existing in Switzerland. In that rugged country an abundance of water-power has taken the place of a natural supply of coal. There is a grand similarity between the two great processes of storage: here we profit by the solar energy stored up countless centuries ago in the form of chemical energy; there the process is in progress before our eyes, as the moisture raised by the same agency crystallises on the mountain tops and stores up potential energy, to be gradually released by the melting of the snows. But there is this important difference between the two cases—that water-power is not commercially capable of transportation over great distances without transformation into some other form, while, on the other hand, it is easy and profitable to convey the coal itself with its store of energy to the place where power is required. Moreover, the localities where water-power is most abundant in Switzerland, are frequently, for the same reason, unsuitable for the sites of factories and towns. Hence arose the need of a system of transformation and distribution of energy over considerable distances, with great flexibility and economy in capital cost. The first attempts in this direction took the form of rope transmission, which in no other place attained to such a high degree of development; but the advantages of electricity soon made themselves apparent, to the exclusion of all other agents. At first, direct current and single-phase alternating currents were employed, but the difficulties attendant respectively upon the use of high pressure direct current commutators, and of synchronous alternating current motors, were such that upon the introduction of polyphase working its superiority was immediately recognised. The simplicity of the machinery, the ready handling of the motors, and the low first cost of the line—a most important factor in this case—were too obvious to be overlooked; and the natural consequence was that the most rapid development took place in the direction of polyphase working, which, in Switzerland, is practically confined to the three-phase system. The adoption of the same system for lighting was due to the desire to avoid the use of the complicated moving machinery which is inseparable from the conversion of alternating into direct currents; some trouble was at first encountered on

the score of regulation, but this was practically overcome by the use of a neutral or return wire for the lighting circuits, and now the three-phase system is almost universally used for the Swiss lighting circuits, the exceptions being small isolated installations, where the advantages of storage are important. Most of the tramways, it is true, are still worked by direct currents, generally obtained from a three-phase plant with rotary converters; but that there is no bar to the application of the polyphase system to traction has been completely proved by the pioneer work of Messrs. Brown, Boveri & Co.

Now, in Great Britain the supply of motive power has been up to the present an almost negligible factor; lighting has always been the chief consideration, and has been carried out by isolated installations close to, or in the midst of, the area supplied, hence there has been no need of transmission over distances exceeding two or three miles at most in the majority of instances, and even where the distance has been greater, the absence of a demand for motive power has permitted single-phase currents to meet the circumstances sufficiently well. Consequently, the line of development in this country has been that of direct and single-phase working, in both of which branches we hold our own as regards the excellence and magnitude of the generating and transforming plant. Long-distance transmission, and electric supply on a polyphase system, are absolutely non-existent here; even those schemes which are projected for transmitting power over some considerable distances are intended to use polyphase working for transmission only, and to distribute with direct currents.

We conclude, then, that we are many years behind the Swiss in the manufacture and use of polyphase machinery, while they lead the world in this department; nevertheless, we are at least abreast of them in the construction of direct current and single-phase machinery. Their turbines are unexcelled; but so are our engines and boilers. The remarkable progress which they have made in the special branches enumerated above must be in great part ascribed to the natural conditions of their environment, and we have seen no cause to suppose that our less forward state is due to any deficiency in the talent or inventive genius of our engineers.

There is, however, another aspect of the question, and this is, to our mind, by far the most important one. We refer to the economic view. Apart altogether from considerations of environment and engineering skill, we have observed the attitude which the capitalists, banks, municipalities, and the public generally have taken towards the development of electrical engineering and its dependent industries; and here we find a startling contrast with the state of things in Great Britain. We are accustomed to see our councils rising in their might to repel the so-called "monopolist," to resist great schemes for distribution of power over large areas at minimum prices, and to crush all native progress. We have seen them act the part of the "dog in the manger," securing powers to provide electrical supply, absolutely in order to prevent such supply being given! We have seen our great companies starving for capital, unable to carry out the extensions so urgently needed, while foreign-made machinery is pouring into our ports. No sooner is a tramway or light railway scheme projected than immediately meetings are held to devise ways and means to oppose the undertaking, often with a view of being bought off at ruinous prices—a process generally known as jobbery, to use the mildest term. We see our municipalities imposing arduous and unjust conditions on British contractors, and simultaneously giving orders abroad without a thought of controlling the wages there. The parrot-like cry of "disfigurement," so long cast in the way of tramway schemes, is happily becoming rare, as the public learns that the good of the many ought not to be sacrificed to the prejudices of the few; but still we see London destitute of electric tramways and our toilers crowded in mephitic tunnels, 15 to the compartment.

In Switzerland there is nothing of this. Far from opposing engineering projects, the people welcome such, knowing the advantages that are certain to accrue to them; capital flows freely into the industry, and the far-seeing directors of the great banking concerns support the schemes. The beautiful and picturesque streets of the towns and villages, the inter-urban roads, and even the mountains themselves, have their well-laid tramways, operated for the most part by water-power.

High pressure transmission lines of bare copper wires on porcelain insulators are commonplace; they are met with everywhere. Yet our Board of Trade will not so much as sanction a few miles of overhead conductors in country districts between villages and townships, at one-fourth the pressure used by the Swiss, but requires costly underground mains, which weigh down the undertaking with excess of capital, like Sindbad's "Old Man of the Sea." Our electrical industry is cramped and fettered by the restrictions which bind it; were it not so, we should soon see great distribution schemes, power transmission over long distances from the coal areas, and even full-gauge railways, electrically operated, as in Switzerland.

How to remedy these evils? "There's the rub"; it is not easy to reach the roots of the canker. Many maintain that technical education is the great panacea; we are convinced that this is but a minor factor in the problem. We went to Zürich honestly looking forward to the visit to the Polytechnikum, prepared to admire, and schooling ourselves to control our anticipatory feeling of envy. We came away with a sense of disappointment. The physical, or more properly, the electrical engineering, laboratories of which we had heard so much, were superior to those of our own technical colleges in but one respect—they are generously supplied with funds by the Swiss Government, whereas our own are dependent on a confused variety of grants, donations and private endowments, and are always starved for up-to-date apparatus and equipment. The methods of teaching are no better than our own; the apparatus, thanks to the ample funds, looks newer and better made (much of the most modern apparatus in our colleges is made by the students—and demonstrators, when they have time, which is seldom), but the type of apparatus is old-fashioned. The tangent galvanometer dominates the department; we saw but one d'Arsonval, and that was of the old pattern; scales are read with telescopes, a method regarded by us as tedious and primitive; alternate current wave forms are plotted with ballistic galvanometers and condensers. We do not wish to convey the impression that the laboratories are inadequately equipped; but we are convinced by actual observation, that our own are at least as well adapted for their purpose, and are in many respects in advance. We paid a visit to the mechanical engineering

laboratories, and found them *half-built*; we inspected the designs, which were admirably complete, but up to the present, we find, there has been practically nothing of this kind. Here we are a long way ahead. The most noteworthy feature of the system of education was, in our opinion, the fact that the students pass two years in workshops, as apprentices, *before* they commence the course of technical instruction at the Polytechnikum. We heartily commend this practice to the notice of our authorities.

Our conclusion is that technical training is not the solution to the problem. We believe that the only possible cure lies in the education of the people of Great Britain; teach them to realise that the prosperity of the nation can only be maintained by constant progress, and to understand the irreparable injury already inflicted upon our commerce and prestige by the blind reactionary opposition to all new things, so characteristic of the British public now a days. Let our daily press take up the work, and drive in the lesson by constant repetition—it is their peculiar privilege to reach the mass of the people as no purely-technical journal can. The British nation is at fault, not the engineer; let the nation encourage and support the engineering industry, instead of striving to restrain its progress—let it learn from the gallant little Swiss Republic how to aid and cherish scientific enterprise, on which the prosperity of Great Britain depends!

PROVIDING FOR ELECTRICAL SUPPLY DURING HOURS OF SMALL DEMAND.

The financial success of the supply of electrical energy may be considered to depend to a considerable extent on the maximum and minimum loads on the plant.

A statement of the total output from any works for a whole year does not reveal any indication of the peculiar conditions of electrical supply; but when the actual capacity of the plant is considered, or, in other words, the total possible output in one hour, it seems surprising that, as a rule, the yearly output could be generated in one month. In many works the plant could in three weeks generate sufficient supply for one year's demand, and even if it were commercially practicable to store up this output, ready for sale when wanted, it may well be doubted if a consecutive idleness of 49 weeks in the year would prove beneficial to the plant.

Machinery, with or without storage batteries, must be provided for the maximum load, and as this load is absolutely under the control of the consumers and can be estimated with considerable accuracy, it becomes possible to provide generating plant and storage in such proportions as will ensure a constant load on the steam plant for many months in the year, an economical load during the summer months and during hours of small demand. This is, of course, no new principle, and long before the secondary battery left the laboratory to become an engineering appliance even more ambitious claims were made for its practical utility.

The capital cost of this method of equalising the load on electrical plant has hitherto been almost prohibitive, and though the present cost of batteries is a very serious item, there is so much to be gained by their use that a liberal interest on the capital outlay may be realised.

The use of storage batteries in this manner must of course be confined to continuous current distribution, and it is probable that existing systems of alternating current supply may with advantage undergo a gradual change to continuous current.

In the meantime, distribution by alternating current does not possess many facilities for securing economy during hours of small demand. The sub-division of plant into machines of convenient variety of size is not an easy matter, for if the works are designed for parallel running, it is difficult, if not impossible, to secure a proper division of the load; and if circuit running is adopted, serious trouble is caused by throwing load from one large machine, say, on to several smaller machines. It, therefore, appears that to secure economy in alternating current generation during hours of small demand—probably 80 per cent. of the year—it is desirable to arrange for a separate plant of high efficiency and durability, fed by separate boilers through short steam pipes.

The Electrical Units.

We recently noticed an article in the *Electrical World* (New York), advancing proposals for a change of nomenclature of the electrical units in such a way that the name of each derived practical unit should denote what multiple or sub-multiple it is of the fundamental unit. We expressed an opinion that the gain derived from such a change would not compensate for the incidental temporary confusion, though if any fundamental change in definition were contemplated, such as the introduction of the Heavisidal unit[e], the system of names proposed by our contemporary would be worth careful consideration. The publication of this article in the *Electrical World* has induced M. A. Blondel to publish at once in *l'Industrie Electrique* an article on the same subject, advancing very similar proposals, which he had prepared for the approaching meeting at Boulogne of l'Association Française. M. Blondel proposes two changes:—(1) To transfer the names ampere, ohm, &c., to the C.G.S. units, each with a temporary prefix to be afterwards dropped. Thus for the present he would call the C.G.S. unit of E.M.F. the neo-volt, and as soon as the system was well established it would be called the volt; (2) For practical purposes to use only three sub-multiples, and three multiples, of the units with the prefixes micro, hypo, milli, kilo, hyper, mega; hypo meaning that the fundamental unit is multiplied by 10^{-2}, hyper by 10^{2}, micro by 10^{-15}, mega by 10^{15}, milli and kilo retaining the present senses. We may refer our readers who wish to study M. Blondel's proposal closely to the French journal, in which the question is discussed at considerable length. There can be no doubt that his system would have advantages over our present one. Names for the C.G.S. units would be very useful, and the new multiples and sub-multiples would bear their descriptions in their names. M. Blondel, moreover, thinks the new derived quantities would be more convenient than the old practical units, but we doubt this. If we are to have a change at all let us have the rational units, and a revision of nomenclature may come at the same time as a subsidiary reform.

D

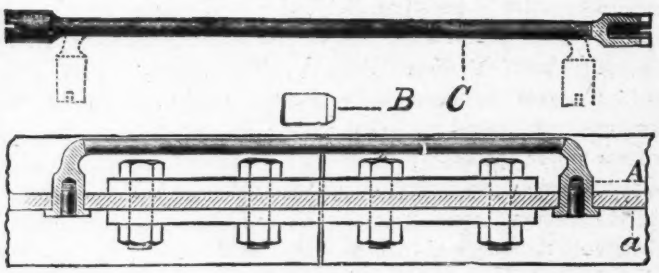
INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 387.)

The last or "uniform" sub-division comprises only one bond, which is known as the "Chicago Crown" bond, and is manufactured in two forms, viz., rigid and flexible. The

The "Chicago" Rail Bond.



Sectional View.

Elevation View.

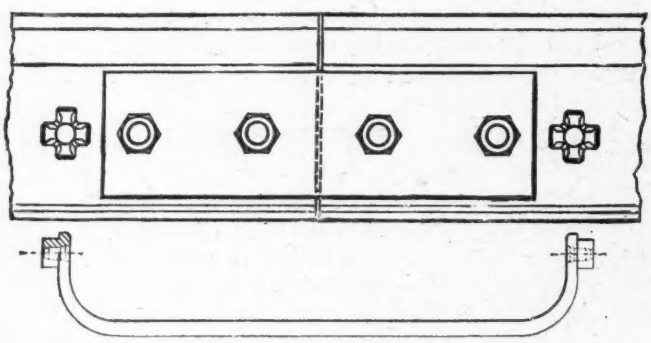


Fig. 90.—"Chicago Crown" "S" Solid Bonds.
For bonding at points and crossings and between tracks.

first form belongs exclusively to the group of long exposed bonds, while the second form belongs to both Group A and Group B. The "Chicago Crown" rigid bond (fig. 90) is forged from a single solid piece of copper, the thimble-shaped terminals having tapering conical perforations of a special shape. When the terminals are inserted in the web holes they are secured by expanding one end of the perforation with a tapering punch, then a tapering drift pin, $\frac{1}{16}$th of an inch larger than the holes, is driven home, the terminals expanded and a lip formed at the smaller end, as in a rivet head. The contact between the iron and copper, in consequence of the pressure thus exerted, is so intimate that it can never be rendered less perfect by working loose, by corrosion, or by electrolytic action. The area of the contact surface is over 11 times the sectional area of the copper bond uniting the terminals. The resistance of these bonds when both terminals and web holes are very clean is under 2 microhms (per two terminals in series), while their conductivity is practically 100 per cent. of that of pure copper. The effect upon the resistance offered by this practically perfect bond, when the web holes are oily or oxidised, or both, is most marked and runs it up to four times the minimum, or 8 microhms (*vide* Mr. Parshall's experiments).

The "flexible Chicago Crown bond" (figs. 91, 92A and 92B) is made both in the long type and in the short type; its terminals are identical with those of the rigid form, and it is fixed to the rail in identically the same way. The difference lies in the portion connecting the terminals. This consists of strands of copper wire laid crossing each other at an angle, which provides for expansion and contraction in the rails without sensible alteration of shape, and allows the bond being fitted without difficulty to the rails at any temperature. The terminals and strands are united by a special process of forge welding, and the union is so perfect that when sawn through the weld the strands are found to have lost their identity, and the whole is a homogeneous mass of copper, and capable of standing to all intents and purposes the same tensile tests. The conductivity of the bond is upwards of 93 per cent. of that of pure copper, which with the same effective cross section of web ($\frac{1}{2}$ inch), and contact area with rail web (1·37 inch), and clean condition of bond and holes as the rigid bond previously described would give a resistance of $2\frac{1}{3}$ microhms (per two terminals in series), or an increased resistance of only $\frac{1}{8}$th of a microhm to set off against the advantages of flexibility and adaptability. The fact of its being made in the short or covered type has the further advantage of enabling the initial cost of the bonds to be greatly reduced. It is interesting to note that Mr. Parshall found the conductivity of the Columbia multiple bond to be only 90 per cent. of that of the Chicago Crown rigid simple bond, while its resistance was from $3\frac{1}{2}$ to $4\frac{1}{4}$ times as great, the bonds being identical in every other respect; this shows how essentially superior the simple uniform bond is when compared with the best examples of the multiple monometallic varieties, and *a fortiori* any other multiple varieties.

The third method of bonding is the one which dispenses entirely with added bonds and ordinary fastenings by the substitution of a special joint, or by the total abolition of all joints. The first process is known under the name of the cast-welded joint, and the second as the endless electric welded rail. The conditions of expansion and contraction of the rails on a railway and a tramway are entirely different; in the former, the rails are practically wholly exposed and wholly free to alter in length in accordance with the changes in temperature, while in the latter they are to a great extent protected and prevented from moving by being embedded in the pavement.

The skin friction between the rails and the pavement and the weight of the latter is so great, that even in extreme climates the contraction or expansion, due to variations in the atmospheric temperature, produce hardly any perceptible movement in tram rails, and practically no allowance need be made for contraction or expansion in laying a tramway track. The only precaution that need be taken is to avoid unbedding much track at one time for repairs in the summer time, should the track in question happen to have been laid in the winter, or *vice versâ*, otherwise "hogging" may take place in the first case and ruptured joints in the second. In a tramway, therefore, the ideal track without joints, so

Fig. 91.—"Chicago Crown" "F" Bonds.

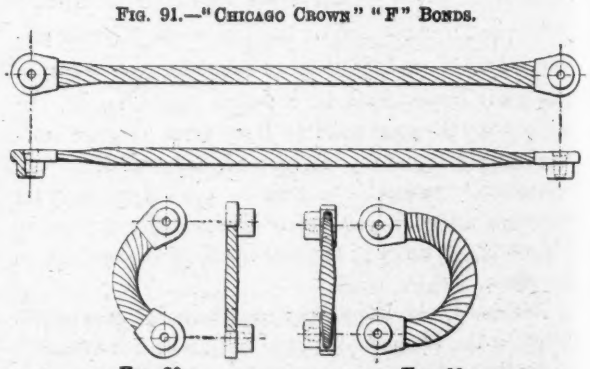


Fig. 92B.
Stranded "Chicago Crown" Bond, Style "T."

Fig. 92A.
Stranded "Chicago Crown" Bond, Style "U."

desirable both from the mechanical and electrical points of view, seems to be a practical possibility. Electrical welding has for several years been the subject of extended experiments in the United States of America, but so far the results have not been such as to encourage tramway companies to adopt this system of bonding. Its drawbacks may be summarised as follows:—

1. Decreased conductivity of the welded portion as compared with the rest of the rail. 2. Increased temper and brittleness of rail at weld, softening of adjacent portions, and consequent increased liability of rails to fracture and to uneven wear. 3. Excessive cost of process as compared with other methods of bonding.

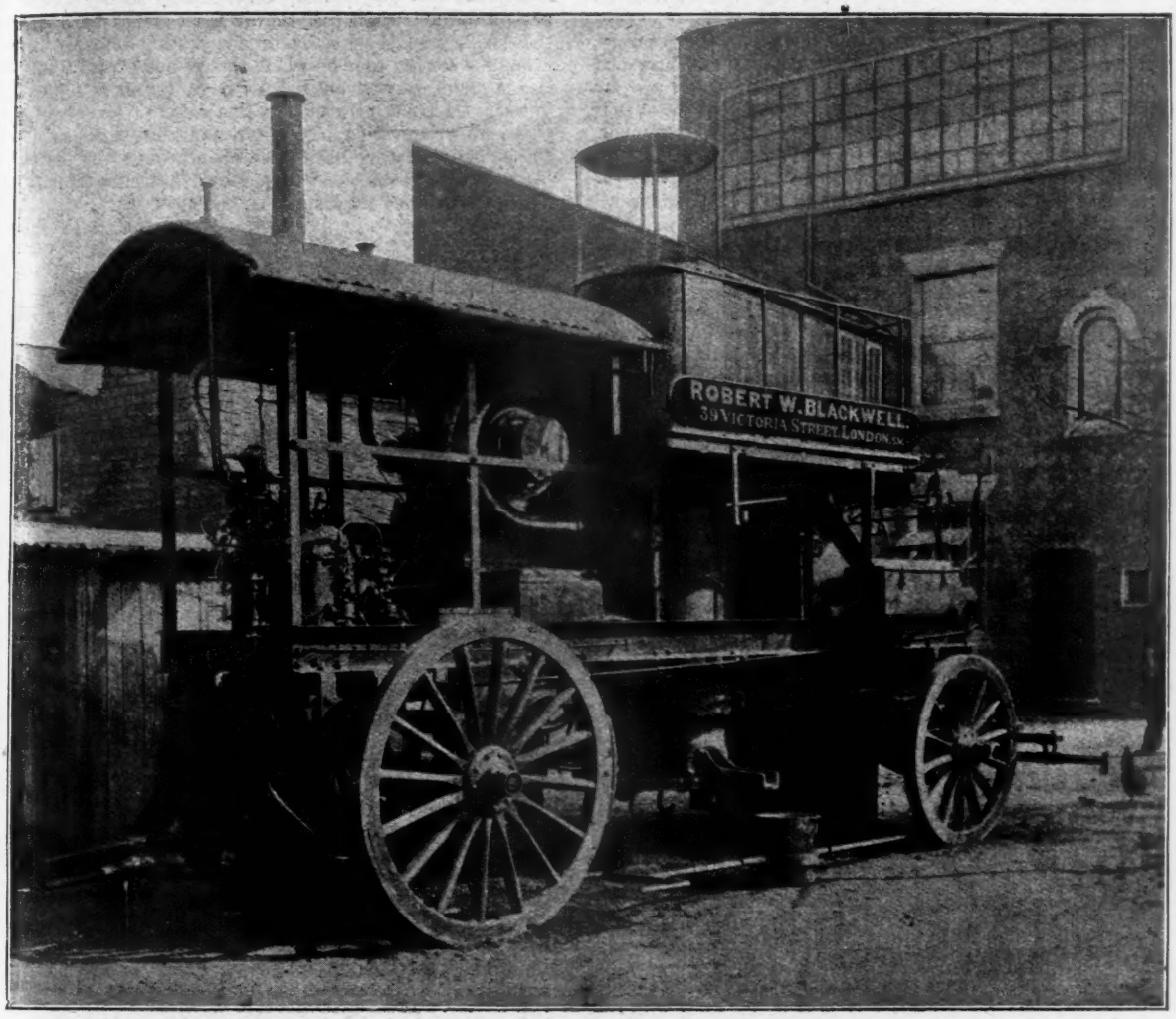


Fig. 93.

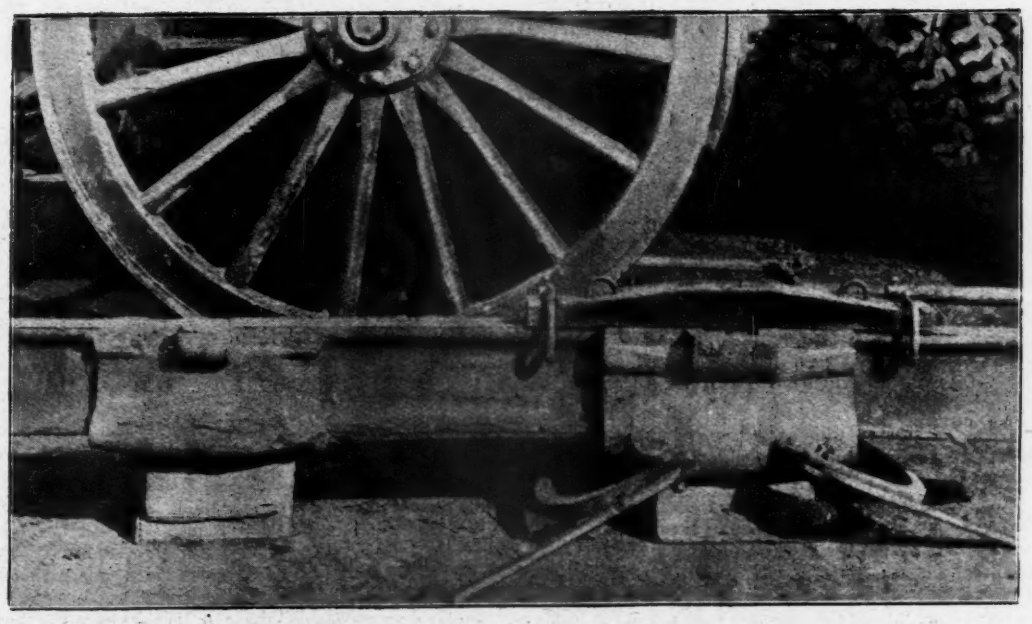


Fig. 94.

The apparatus required for electric welding is costly, and in practice the required power is not always easy to obtain,

so that although the drawbacks mentioned above might no doubt be removed with more extended experience, still it is not to be wondered at if the process has not as yet been tried on this side of the Atlantic.

The cast-welded or "Falk" joint has, on the contrary, been extensively tried in England, both at Coventry and Norwich. By this system the joint is done away with by casting a cast-iron sleeve round the sides and bottom of rails at their joints. A metal mould is fixed round the rail ends, a special mixture of cast-iron is run into this from a portable cupola; the molten metal cooling rapidly in contact with the mould, shrinks, exerting great pressure on the embedded rails, ensuring a thoroughly good mechanical joint and electric bond. The size of the joint is such as to ensure the same tensile strength as in the remainder of the rail. These joints are generally 14 inches in length, and from 70 to 140 lbs. in weight, proportionately with the weight of the rail. Figs. 93, 94 and 95, show the movable cast-welding plant, a joint with mould in position for casting, and a section through a cast joint respectively, as carried out by Robert W. Blackwell and Co. at Coventry and Norwich. This joint has been undoubtedly a mechanical success, owing to the slight clearance

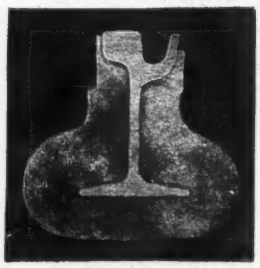


Fig. 95.

afforded by the contracting of the rail after the cast sleeve has set being just sufficient to admit of a slight play for contraction and expansion in the rail ends. But this clearance, though of the slightest description, accounts for the variations that have been observed in the electrical resistance of the joints when new, and will probably cause this to sensibly increase with time by the deposition of a slight film of oxide between the cast-iron sleeve and the embedded rail ends. On the whole, however, this system of doing away with rail joints has been undoubtedly a great success, its only drawback being the question of cost, this being specially noticeable where the casting plant has to be brought into operation for a few joints at a time, such as occurs when small extensions or repairs have to be carried out, especially in this country, where only two or three yards of road can be opened at once. It has been practically demonstrated that unless one mile of street can be opened up at a time the cost of each joint is very great.

THE INSTALLATION OF STEAM BOILERS.

VII.

So far the structure of the boiler has chiefly been dealt with. Before dealing with the fittings, we may take a brief glance at the question of the brickwork in which the boiler is built. It is almost superfluous at this date to insist on the necessity for absolute dryness of foundations, and if only a damp site is available, it becomes necessary to construct a tank of sound concrete, rich in cement, and put in sufficiently wet to be waterproof, and of such size as to be removed from the effect of the heat by sufficient thickness of bricks. Under the most careful construction in such cases the concrete floor should have a fall to some accessible sump, or water catcher. Failing a dry foundation, the moisture creeps up the brickwork of the seating walls, and causes severe corrosion of the plates along the line of seating.

Years ago, when no care was exercised as to the selection of the site of a boiler, explosions from this cause were frequent. This class of explosion has nearly disappeared. In ordinary practice, as developed by long experience, a boiler is set upon two longitudinal walls, parallel to one another, and distant apart over half the diameter of the boiler. On these walls are laid specially formed seating blocks of firebrick, the seating edge of which should not exceed 3 inches in width, and may advantageously be convex in profile so as to touch the boiler plate along a line only. Where the ring seams cross the seating blocks, a rectangular gap should be cut across the seating for purposes of inspection, and specially formed wedge pieces ought to be provided to close these gaps. These are removed for inspection, and at once replaced.

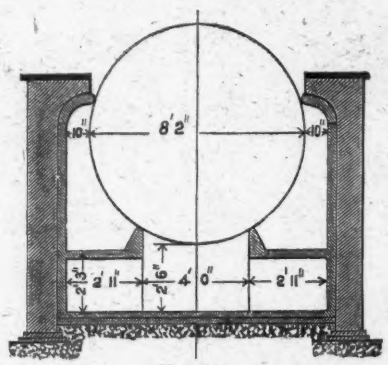


Fig. 19.

The course followed by the gases issuing from the furnace tubes is first along the bottom flue, and this flue should be from 27 inches to 30 inches deep below the extreme bottom of the boiler. This depth admits of convenient inspection. Any much greater depth prevents a convenient seated inspection, but there is no objection to a very deep bottom flue if circumstances render this desirable, in which case the depth should be such as to permit of a standing inspection. The reason for the bottom flue being the first taken by the gases is that the bottom of the boiler may be kept as warm as possible. When the side flues were kept the hotter, the riveted seams on the boiler bottom were liable to be torn. This was known as the seam rip and was due to unequal expansion between the upper and lower parts of the boiler.

The formation of the side flue should be such as to admit the very easy passage of a man with full liberty to inspect along both seat and flue cover lines of contact. The use of

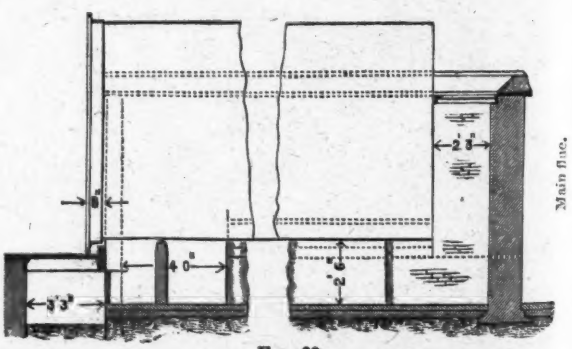


Fig. 20.

the specially formed seating block allows an ample space along the bottom of the side flue, the outer wall of which should not be less than 9 inches clear of the boiler at its horizontal diameter. The side flue covers are quadrants of a firebrick cylinder 3 to 4 inches thick, and these may with advantage be convex on the face next the boiler plate. These covers may be placed about 6 inches above the level of the furnace crown, but there need be no fear, if it is thought desirable, of completely arching in the boiler crown so as to admit the gases over practically the whole crown in a space of 4 inches thickness. It is most essential that all the brick

work, especially of outer walls, should be sound and air-tight. For this end the front wall should be faced with glazed bricks set in cement, and any exposed side wall should be repeatedly tarred or painted to render it air proof.

Where boilers are set in batteries, the dividing wall between the side flues of contiguous boilers should not be less than 9 inches thick, and all flue walls must be internally lined at least 4½ inches in fire brick. Division walls may be 13½ inches if there is enough ground area to permit of this. The back down-take admitting from the furnace tubes to the bottom flues is often made 27 inches wide from the boiler end plate to the back wall. This is a fair allowance, but it may well be made 30 inches if space permits.

It is usual to build a mid-feather wall to divide the streams of gas from the two tubes, such mid-feather continuing a couple of feet along the bottom flue. Unless the

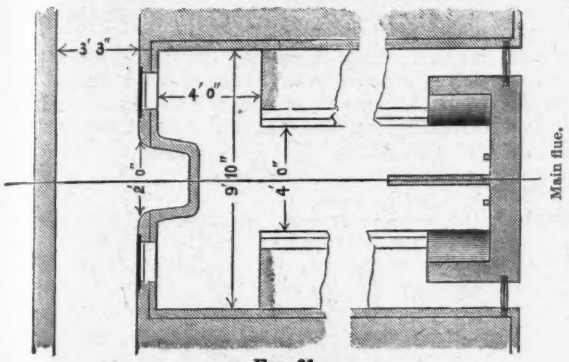


Fig. 21.

boiler is at least 90 inches diameter, anything over 4½ inches thick is rather in the way, while a 4½ wall is very short lived. A mid-feather is often advantageous in preventing a tremulous draught. A bituminous coal cannot be smokelessly consumed where the draught is tremulous. The best covering to these rear down-takes is a larger quadrant tile of the same type as the side flue cover tiles. These will prevent a tremulous draught where one has existed with a flat topped down-take. But by far the most convenient down-take cover is a flat plate of cast-iron fitted in a frame built above the down-take. The flat plate can be lifted by the usual T head key and access gained to the down-take from above. This forms a good mechanical finish. For convenience of inspectors there should be left projecting from the back wall of the down-take one or two brick headers about 2 inches projection. One should be placed opposite the middle half of the flue tube and one or two at a lower position for foot rests in descending to the bottom flue. It is now considered best practice not to build the covering bricks over the side flue cover close up to the boiler, but to leave a narrow trough to enable the shell plate to be got at for inspection, this trough being filled with loose material, easily moved for inspection. Then the shell of a boiler is open to inspection all over, and if not arched over on the crown, this is covered with some compound which is at once loosened and softened by any leakage of steam, which is thus at once rendered visible. The inability to see the boiler crown is the real objection to the arching over of the flues. But if this arching is adopted, it should stop at least 4 inches clear of all mounting blocks. It was because of being closely bound in by the over-arching that a very serious triple explosion occurred some years ago. All the evidence pointed to the probability of the boiler having been hung by the manhole mouthpiece upon the over-arching, the seating below having settled and thrown the weight of the boiler upon this mouthpiece. In our illustrations, figs. 19, 20, 21 and 22, the various points touched upon may be studied. It should be added that the front wall of the seating must be placed behind and clear of the angle ring of the front end plate. This plate thus stands about 7 or 8 inches in front of the wall. This wall is usually 9 inches thick, and where it makes contact with the boiler, it should be reduced at least to half a brick. Indeed, there ought to be special narrow edged bricks moulded for this purpose. Below the boiler this front wall must be recessed and taken behind the blow-out block. When the blow-out pipe comes through the front wall, as once common, it often broke off when foundation settlement let the full weight of the boiler upon this one pipe. A space of 4 feet is left between the ends of the seating walls and the front wall to admit the gases to the side flues. The hearth pit is made at least 6 inches, preferably 12 inches, and often 15 inches deeper than the bottom flue; this prevents danger of water in the flue from the hearth pit. The openings to the flues are best made through the front wall in the hearth pit at each side of the blow-out recess. These openings may be 18 inches square where the bottom flue is not less than 30 inches deep. They consist of a cast-iron frame and a close-fitting door hung on lugs. The frame must be flush with the flue bottom to allow dust to be brushed out easily. The hearth pit often measures 39 inches in width between walls, and should be a continuous trough along the front of a set of boilers. Nothing should be allowed in the hearth pit except the blow-out tap and pipe. It is bad practice to allow feed pipes to be laid along the pit. It is usual to lay the waste pipe into which the various blow-outs discharge along the pits. It is a very undesirable practice to have a waste pipe common to two or more boilers owing to the danger of blowing back into an empty boiler of steam and water from a boiler that is blowing off.

The safeguard of a single key, which can only be removed from the blow-out tap when this is closed, is theoretically infallible, but it is easy to suppose the key lost, a new one obtained, and the old one found, when there would be two keys, and perhaps everyone would not know of it. Therefore, avoid a common waste pipe, carry all blow-out wastes, if possible, to their own independent discharge. Failing that, it is possible that a waste pit with freely open standpipe to the air might be permitted. If a common waste pipe must be used, it should increase in size as it passes along the line of boilers. It should be single-ended only, and each boiler branch should point in the direction of flow, so as to induce a current to the discharge end, which should be protected from frost.

Hearth pits are usually covered by plates of cast or wrought-iron set in a frame. Each plate should be not over a foot in width, and it should not exceed $\frac{1}{16}$ths in thickness, with a stiffening rib. Each plate should be edge planed, and have chipping bits at each corner to fit them free from rocking movement in their places on the framing. It should have a slot at each end for a ⊥ key, and should be free from twist and an easy fit in the frame when the boiler is under full steam. The middle plate requires a small circular hole, with cupped cover plate, to take the blow-off key, and this middle plate ought to be lifted for an inspection of the hearth pit every day. This centre plate is supported by a flange along the

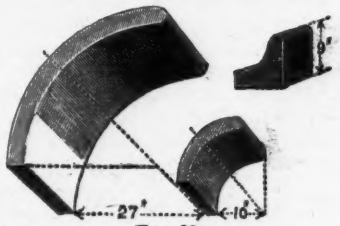


Fig. 22.

under side of each adjoining plate. It is considered permissible to take the waste pipes from the glass water gauges into the hearth pits, because otherwise the blowing out of the gauges is a nuisance, but this practice is rather apt to cause mild corrosion of the shell plate round the blow-out block. If a through draught can be secured from end to end of the hearth pits this should be done. Sometimes hearth pits are uncovered, being merely protected by a kerb of stone. This is good practice, in the writer's opinion, if the stokers will keep the pits clear of ash and coal. A portable plate or two may then be employed to carry the ash barrow when cleaning fires, and each blow-out tap should have a covering cap. By means of a set of rails an ash trolley may be run along the front of all the boilers for this purpose. The bottom of hearth pits, whether these be open or otherwise, should be smooth cemented, and sloped to the middle of the pit and one end to promote drainage. The advantage of the open hearth pit is this: Where cover plates are employed these must be fully 1 inch clear of the

lower edge of the front end plate, or there is liable to be an accumulation of damp ashes about the angle iron ring. Serious corrosion has been thus caused. The open pit can conveniently be arranged with boilers of 7 feet diameter. But with boilers of 8 feet, and the large angle rings demanded by modern pressures, the grate surface is raised so high above the firing floor as to reduce the efficiency of the fireman.

With open hearth pits the front end plate may project below the level of the floor with safety. Where cover plates are retained, the bearer along the boiler front wall should have a back flange at least 4 inches high, and rising at the middle to fit round the boiler shell. This fender flange is to prevent the fall of ashes into the hearth pit, and generally to give a finish. It is customary to keep this plate bright in well kept boiler houses. Over the whole of the brickwork above the side flues one of the neatest ways of finishing the work is to lay thin, smooth flags of York stone, with rounded edges, where they overlap the brickwork. The best system of damper is that which provides a narrow damper to each side flue. These side flue dampers slide in a light frame of cast-iron built into the walls of the flue, which is here widened out to 12 inches. The damper opening is 12 inches, and the damper itself, if carefully fitted, need not exceed 13½ inches in a well-made frame. If circumstances permit, the narrowest part of the side flues may be greater than 9 inches, but should not usually exceed 12 inches. Each damper should be balanced by a weight hung by a chain over a pulley, carried on a pillar or frame suitably supported. On the axis of the pulley should be fixed a light wheel of 20 inches diameter carrying a flexible steel cord ⅜ths inch diameter. This cord is brought to a convenient spot on the firing floor—preferably down the pillar or pier of the large doors usually found closing the front of the boiler house. By this cord the dampers can be raised or lowered. It may either be a continuous cord or, if single, the balance of the damper must be imperfect, so that the damper will move in one direction by gravity. Obviously the damper gear must be liberally proportioned, and finished in a mechanical manner.

It is to be regretted that in items forming the substance of this chapter the fitting and finish of boilers and boiler houses which have been carried out by electrical contractors are often deplorably behind the best recognised practice.

A distinctly retrograde movement has been made as compared with the recognised standard of the leading boiler insurance companies. Much of what these articles contains is, in a sense, ancient history, and would not have been set down had it not appeared that there was a distinct need for it. An inspection of almost any modern factory in Lancashire, or even in Yorkshire, will show a practice differing but little from what has been here set down.

In actually setting a boiler, it is usual to first build up the brickwork as far as the level of the side flues. The boiler is then supported over its seating upon two sets of timber blockings laid in the bottom flue. It is set with a slope of $\frac{1}{16}$th of an inch to the foot of length towards the front end to facilitate blow-out and washing. The seating blocks are then put in position and firmly wedged in place to carry the weight of the boiler, fireclay only being employed as mortar. The boiler is then allowed to bear on the side walls by removing the temporary supports, an operation, perhaps, best effected by a screw jack, but sometimes by breaking up the old bricks which have formed one layer of the temporary supports. In designing a boiler seating, plain straight line work should be used as far as possible.

(To be continued.)

OVER-COMPOUNDING DYNAMOS.

By E. K. SCOTT.

In over compound wound dynamos it is necessary to increase the magnetism at a rate roughly proportional to the load needing the over-compounding. It is important, therefore, to work between such points on the magnetisation curve that the useful lines of force are somewhere proportional to magnetising force, or, in other words, that part of the B H curve which is immediately below the corner leading to saturation, say, *x y*, fig. 1. Working at a low point in the curve

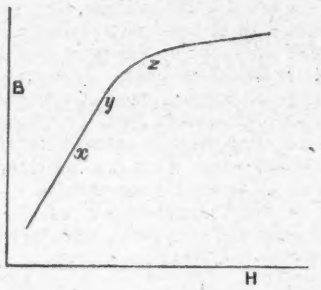
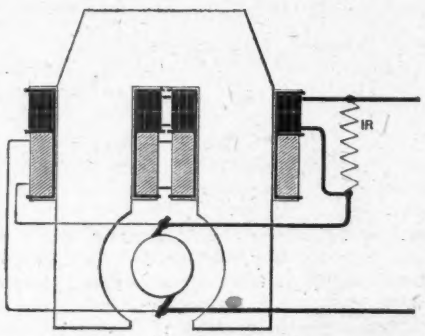


Fig. 1.

naturally means a reduced output per unit weight of material, and various propositions have been made to enable the machine to work at a higher induction density and still give the same over-compounding result. Fig. 2 shows one method



I R, Iron wire resistance.

Fig. 2.

which has the advantage that it is automatic. An iron wire resistance is put in shunt with the compound coils, and its section is so proportioned that increase of load, combined with the high temperature coefficient of the iron, shunts more and more current through the series coils, thus compensating for the diminishing permeability of the magnetic circuit at the part of the curve, *y z*. The coils themselves, and the losses in them, of course cost money, but the increase in output for a given sized carcase more than covers this.

It will readily be seen that a similar arrangement can be used in which the regulation is by hand, as in fig. 3, and

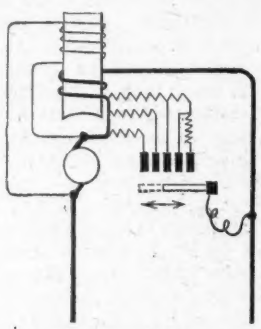


Fig. 3.

this latter method has the advantage that the band of the voltage curve can be compensated for.

An interesting fact, observable especially on traction machines where the load varies greatly, is that over-compounding tends of itself towards sparkless commutation; for the increase of magnetisation corresponding to the increase of voltage from 520 to 580 volts gives just the necessary strength of field for commutation without shifting the

brushes. In other words, it is a distinct gain to over-compound a machine even when such over-compounding is not absolutely necessary from the point of view of getting a steady voltage at some distant point. Seeing that over-compounding means very little extra complication, it would appear that it might, with advantage, be applied to ordinary central station lighting dynamos, which are at present always wound shunt.

Some specifications for lighting dynamos have recently been issued, in which the ordinary shunt-wound machines to give 460 volts were asked for, but there was also the proviso that if at any time electric traction should be decided on, the dynamos should be able to give the voltage required for this work by the simple addition of series turns on the field coils.

Now, with 220-volt lamps, the voltage of the dynamo is generally fixed at 460 volts, whilst for the ordinary 500-volt traction motor the pressure at the generators may be anything between 520 and 580 volts. Say the highest voltage required is only 560, then it means that the mere addition of series turns to the dynamo has to add 100 volts, or 22 per cent. Such a thing might possibly be done, but what about the expense? As pointed out above, the only way to make provision for increase of voltage is to work low down on the magnetisation curve. To utilise lighting dynamos in the way suggested, therefore, means that when running on lights the fields will be very weak, and this, as everyone knows, is an invitation to sparking troubles at the commutator. As the machine must necessarily be of low efficiency and expensive, the game hardly seems worth the candle; besides, it is more than probable that when the traction scheme does come along, the idea of using the lighting machines for the purpose will have been abandoned. Using a higher voltage lamp than 220 would help to get over the difficulty, but the writer thinks that this idea of working lamps and a traction load from the same machines should be dropped. It looks pretty on paper, but it doesn't pan out quite right in practice.

REDUCED RATES TO INDIA.

We are glad to reproduce the following:—

Upper India Chamber of Commerce,
Cawnpore, *August 15th*, 1899.

The Under-Secretary to Government,
North-Western Provinces and Oudh,
Public Works Department,
Naini Tal.

Sir,

Reduction in Telegraph Rates between India and Great Britain.

In connection with the correspondence ending with your letter, No. $\frac{1840}{125}$M., dated Naini Tal, June 9th, 1899, advising that the Government of India "had addressed the Secretary of State with a view to securing a reduction of not less than 50 per cent. in the present tariff, at as early a date as may be practicable," I am directed to express the hope that His Honour the Lieutenant-Governor will support this further representation on the subject, as the facts which have been recently made public in England, regarding the working of the Anglo-Indian telegraphs, appear to accentuate the practicability of the views held by the Upper India Chamber of Commerce, viz., that a shilling per word rate would largely increase traffic and yield a fair profit on the working of the system.

In the course of an interview granted by the Chancellor of the Exchequer to a deputation of members of Parliament on July 12th, 1899, Sir Edward Sassoon stated that "A new telegraphic line had been sketched out by the Indian Government, which would supersede the existing Eastern Company's route to the East, and would give them cheaper rates and a safer line." The Chancellor of the Exchequer is also reported to have said that he was disposed, so far as his personal opinion was concerned, entirely to admit that; at any rate, with regard to India, there was a very considerable grievance in the cost of telegraphic communication, and that some such system as that suggested by Sir Edward Sassoon would do a good deal to improve the position in this matter.

Again, from the evidence given by representatives of the Eastern and Eastern Extension Telegraph Companies before the Pacific Cable Committee, it would appear that in the case of telegrams to Australia sent *vid* India, only 1s. 4½d. per word is received by those lines which transmit the message from London to Bombay, the balance of the total charge of 4s. 9d. per word being allotted to the lines on the route further south. In other words, the Indian public is paying 2s. 7½d. more per word for the transmission of its messages to London, than is paid by the Australasian community for the transit of their messages from India to London, exactly the same distance, over exactly the same route.

The Marquis of Tweeddale, as chairman of the Eastern Telegraph Company, in communications addressed to the Press in defence of the company, states that: "With respect to India, the Eastern Company has already intimated to the Chambers of Commerce that it is prepared to negotiate for a reduction in the Indian rate, and has good reason to believe that negotiations with that object will soon be commenced between the India Office and the company." He further adds:—"As for the press rates, they are nominally less than the commercial tariff, no coding is permitted, and 'expansion' is inconsiderable, so that the present charges, it is admitted, bear more heavily than they might perhaps do on the purveyors of news." And he then goes on to say, "Supposing reductions of rates should, however, lead to a great increase of business, our cables would not be sufficient, and we should have to spend money in providing others."

The vice-chairman of the Eastern Telegraph Company, in a letter dated June 8th, 1899, addressed to the chairman of the Glasgow Chamber of Commerce (copy enclosed) clearly indicates, however, that if a reduction in tariff rates be made, the company will look to the Indian Government to bear a share of any *loss of revenue* which may be thereby caused; and in the memorandum accompanying the letter it is stated that experience has shown the traffic between India and Europe to be a non-expansive one. Further, that the company have not received a single application for reduction of rates from merchants, who are the actual users of the telegraph, ignoring the fact that the said merchants and others have for years been in communication with the Home and Indian Governments on the subject, through their representatives, the various Chambers of Commerce in England and India. Again, the allegation in the said memorandum, that the Indo-European traffic is non-expansive, hardly coincides with the chairman's views as to the possibility of a reduction in rates bringing about a large increase of business, necessitating the laying down of additional cables by the company.

But as it pays those interested to convey messages from London for Australia, as far as Bombay, for 1s. 4½d. per word, it would presumably be a fair speculation to either duplicate the existing system, or to provide another route, if need be.

My committee hold that the reduction in tariff rates to 4s. per word in 1896 still left the charge at too high a level to induce any considerable expansion in traffic, but that, as originally advanced by this Chamber, 1s. per word rate, while constituting a great convenience to trade, the general public, and the Press, would yield to an independent line a volume of traffic sufficient to allow of the system being worked at a substantial profit. I am, therefore, directed to express the hope that, when forwarding this letter to the Government of India, his Honour the Lieutenant-Governor of the North-Western Provinces, and Chief Commissioner of Oudh, may be able to countenance and support the opinion of this Chamber as to the feasibility of 1s. per word rate between Great Britain and India, with a maximum charge of 2s. per word for the privilege of priority of despatch over other messages, so as to meet the cases cited by the vice-chairman of the Eastern Telegraph Company, "Limited," in paragraph 2 of the memorandum attached to the communication addressed by him to the Glasgow Chamber of Commerce.

I have the honour to be, Sir,
Your most obedient servant,
W. B. Wishart, *Secretary*.

Reduction of Telegraph Rates between India and Europe.

The case for the Companies.

The following letter and memorandum have been received by Mr. John Galloway, chairman of the Glasgow Chamber of Commerce, with regard to the movement in favour of the reduction of the rates charged for telegraphing to India and the East:—

Eastern Telegraph Company, Limited,
Winchester House, Old Broad Street,
London, *June 8th*, 1899.

Sir,—Referring to our interview of the 1st inst., I now enclose copy of a memorandum which has been prepared with regard to the Indian tariffs. This memorandum can be freely used, and it has been submitted to our partners, the Indo-European Telegraph Company.

I can only repeat that these companies are willing to consider any offer which may be made to them by the Indian Government for a reduction of tariffs, and are equally prepared to bear a share of any loss of revenue which may be caused by the reduction required.

Yours faithfully,
J. Denison-Pender, *Vice-Chairman*.

Memorandum.

From some years past the company carrying the traffic between Europe and India have been memorialised to reduce the Indian rate. The companies have always expressed their willingness to reduce tariffs whenever experience has shown that a natural expansion of traffic has taken place, and is likely to take place by a reduction of tariffs, and have also always been and are now willing to take a fair share in any reduction of tariff, if the Governments concerned would bear a proportion of the actual loss of revenue, the companies not only bearing a share of the loss, but undertaking the extra expense of carrying any increased traffic. The reasons which have influenced the companies with regard to the Indian tariff have been as follows:—

1. The traffic between India and Europe has been shown by experience to be a non-expansive one, and the companies consider that it would require a very large reduction of tariffs to materially increase the actual traffic carried. The following figures will speak for themselves. The tariff was reduced to 4s. per word on July 1st, 1896:—

	Words.	Revenue.* £		Words.	Revenue.* £
1885 ...	2,158,521	394,270	1892 ...	2,300,823	364,196
1886 ...	2,153,507	374,121	1893 ...	2,367,353	376,237
1887 ...	2,134,002	342,271	1894 ...	2,190,102	347,728
1888 ...	2,110,163	334,129	1895 ...	2,195,916	358,724
1889 ...	2,029,149	328,490	1896 ...	2,180,158	353,683
1890 ...	2,111,456	338,394	1897 ...	2,370,103	370,428
1891 ...	2,250,074	354,749	1898 ...	2,275,371	365,019

* Revenue of administrations owning the telegraph lines between India and Europe.

2. In all the correspondence which the companies have had with the merchants who are the actual users of the telegraph, we have never had a single application for a reduction of tariffs, but we have had applications to be allowed to send at a higher rate, in order that one person's telegrams might have the preference over those of others.

3. The perfection, to which the system of coding telegrams has been brought, practically reduces the charge of 4s. per word to India to about 2d. per actual word sent by the merchant, a figure that cannot be called dear.

4. If the traffic were to increase through a reduction of rate so as to recoup the companies for the total loss made, it would necessitate the laying of extra cables between Great Britain and India, a single line of which could not be laid under a million and-a-half of money, and if this large increase took place, the companies would have to face this additional expenditure of capital, with the consequent annual charges for interest, maintenance and working.

A HAPPY DESPATCH!

How many readers of the Electrical Review have any knowledge of the long-forgotten Pneumatic Despatch Company's railway between the G.P.O, St. Martin's-le-Grand, and Euston Station? It ceased working in the year 1869 or '70, and the first engineering experiences of the writer were gained on that line, abandoned for 20 years, and now about to be again operated by electric traction in place of air pressure and vacuum. A very exhaustive and interesting report on the inception and history of the ill-starred Pneumatic Despatch has just been made by an engineer, Mr. George Threlfall, a copy of which he has kindly placed at our disposal.

In 1895 it came to his knowledge that there was a tube running underground in London, having been built by a company about 30 years back for the purpose of conveying mails, parcels, &c., by pneumatic despatch.

It occurred to him that if the tube was still available it might be possible to utilise it for its old purposes, if worked by electric traction, but the tube had been closed for so many years that all the plans and records of it seem to have been lost, and it took practically three years to collect sufficient information and plans to enable Mr. Threlfall to draft out a feasible if not a perfect scheme.

The tube runs from the G.P.O., up Newgate Street and Holborn to Tottenham Court Road, up the Tottenham Court Road and the Hampstead Road, turning down Drummond Street and Seymour Street, and then turning up to the Northern District post office on Eversholt Street. It is of cast-iron, 4 feet high, and 4 feet 6 inches wide, and about ¾ inch thick.

Mr. Threlfall found it to be nominally the property of a company called the Pneumatic Despatch Company, founded in 1859, but which had lost its rights by effluxion of time. He hunted up the prospectus and history of the old company, and found that it had been a very powerful one, having been granted special rights by Acts of Parliament enabling it to open up the streets, and do all that was necessary to lay down and keep in repair its tubes for the purpose of despatch in any part of London.

Its board of directors consisted of the Marquis of Chandos, Mark Hulse, Esq., Thomas Brassey, Esq., Edwin Clarke, Esq., John Horatio Lloyd, Esq., Hon. Wm. Napier, Sir Charles J. H. Rich, Bart., W. H. Smith, Esq., with T. W. Rammell, Esq., and J. Latimer Clark, Esq., engineers; John Aird, Esq., contractor; and Baxter, Rose, Norton and Spofforth, solicitors.

He saw all the surviving members of this board with the view of inducing them to aid him in resuscitating the company, and working their tube by electric traction instead of pneumatic despatch, and practically all the old stockholders of the company were interviewed, proxies procured from all, and affidavits from some. After endless delays and disappointments, Mr. Justice Vaughan Williams, in the High Court of Chancery, resuscitated the Pneumatic Despatch Company, with all its original powers, on June 6th, 1896, and an agreement between the Old Pneumatic Company and the New Syndicate (the London Despatch Company) was duly signed in May, 1899.

Mr. Threlfall having satisfied himself that the tube was suitable for electric traction, and that he could obtain possession of it on reasonable terms, he approached the Postmaster-General with a view to finding out the views of the G.P.O. as regards the utilisation of it if re-equipped with electric power. He saw the Secretary, Mr. Preece (chief engineer and electrician of the G.P.O.), and subsequently Mr. Fleetwood (his assistant), who really administers the despatch and electrical departments, and found that although they could not commit the Treasury by making positive statements, they personally were quite ready to entertain the matter, and give it their very careful consideration and qualified support, and there is little doubt but that the Postal Department will utilise the tube when electrically equipped, particularly as the requirements of the G.P.O. have increased enormously since it was laid down on the pneumatic system. One of the chief difficulties the G.P.O. experiences at present is to get prompt delivery of the mails to the different stations in contract time (8 miles per hour), owing to fogs, slippery pavements, congestion of traffic, &c., and there are no parts of London where they suffer more from these causes than in those under which the tube passes.

Since the date of the construction of the old tube, the G.P.O. have built a new Western District office in Holborn, on the route of the tube, and there is a large traffic, both in mails and parcels to and from that office. The Euston traffic is extremely heavy; in fact, the postal authorities state that it is heavier than any of the other station mails, the heaviest hour of the day amounting to 11 tons of mails. That to the Northern District Post Office, Eversholt Street, is also very heavy. They therefore look upon a scheme that will give them, in the first place, quicker service (say, 25 to 35 miles an hour), and one that will not be subject to street traffic obstructions and conditions, with great favour, and although they will not enter into a hard and fast contract until they have plans, particulars of delivery, speeds, &c., put before them, and guarantees offered, there is little doubt but that they mean business, as they have not only given Mr. Threlfall every assistance up to the present, but have offered to do everything in their power to facilitate the re-equipment of the tube.

When first the old company was reinstated, Mr. Threlfall began to consider the best way of re-equipping the tube without raising too much cash capital. He therefore approached some friends, building and railway contractors of first-class repute, with a view to their undertaking to repair and put the tube in order. He also requested a large firm of electrical engineers to undertake the electrical equipment; and he approached Prof. Carus-Wilson for the purpose of his preparing the plans and specifications for the equipment of the tube electrically. After having thoroughly explained the matter to these firms and gentlemen, and having taken their representatives into the tube, they each undertook to contract for the work required, and instead of asking for cash for the work done, undertook to accept payment in debentures of the new company.

The acceptation of the work by each of them on the lines of payment in debentures and shares gives, Mr. Threlfall thinks, the greatest proof possible of what practical men think of the prospects of the proposed company, which will not give them one penny for their work unless the scheme is a success.

During the time the old company was non-existent, the tube was practically no man's property, and the St. Pancras Vestry could not be blamed for taking advantage of it for the purpose of running their electric wires, but we understand they have now fully recognised the ownership of the Tube Company.

Regarding this, the most important vestry along the route, and the only one which is trespassing in the tube, Mr. Threlfall has approached them, offering to give every assistance in his power to enable them to remove their wires in the most convenient manner, and at the same time he has proposed to take from them some of the electric current which will be required in place of building a separate electric station for the generation of electricity.

In Buda-Pesth a line on exactly this principle is at the present time being laid down for identically the same purpose of carrying mails and parcels. At the same time wishing to get reliable and unbiassed opinions on the subject, Mr. Threlfall approached several of the chief authorities, and they all approve of it.

Satisfactory arrangements for financing this undertaking have, we are informed, been made, and a company bearing the name of the "London Despatch Company, Limited," was registered on May 19th, 1899, with its offices at No. 50, Fenchurch Street, London, E.C., with a share capital of £10,000 made up of £10,000 shares of £1 each, and the power to issue debentures up to the same amount.

The idea of forming a small company at the first, instead of a larger one, has been adopted more with a view to allocating the different interests acquired during the last five years in a parent company, and also with a view to the small company finally settling with all vestries, clearing and repairing the tube, drafting out the electrical equipment, equipping one section for Post Office and other experiments, and finally procuring the Post Office contract and bringing out a larger company. For this purpose it is considered the money subscribed, namely, £5,000 cash on debentures already subscribed, having the right to raise a further £5,000 cash on the remaining debentures, is ample.

The steps which the directorate now intend to take are, first, to obtain a recognition of their powers from the various vestries through which the tube passes, and then an undertaking from three of the vestries at least to supply the company at a reasonable rate with the electric current which may be required.

Prof. Carus-Wilson is now drafting out the actual requirements of the company from the electrical point of view, and probably the piece of tube between Euston and Eversholt Street Post Office will at once be equipped for experimental purposes, and the experiments will be carried on under the personal guidance of Prof. Wilson.

While the Professor's experiments are proceeding, an entrance will be obtained to the tube at sundry points, and the tube will be repaired where necessary, and the railroad put in thorough order for running cars.

The minutest details will be obtained of the General Post Office authorities' requirements, so that a full report and scheme may be put before the Postmaster-General with a view to procuring a firm contract from him. The requirements of all the railway companies having receiving offices on the route, of the general carriers and delivery companies, &c., will be carefully studied, and provisional contracts entered into with them where possible.

Having completed all these different details, and having obtained the General Post Office contract, and any other contracts from railway companies or carriers, the parent company will bring out its larger company, and finally equip the tube to its full working capacity.

The writer, who was closely associated with the final struggle of the Pneumatic Despatch Company, when after six months of regular daily work the scheme was abandoned and passed into oblivion, has often wondered why that which has now come to pass, was not undertaken at an earlier date; but it has been left to Mr. G. Threlfall, the managing director of the new company, to make what we hope will prove a success of an underground railway, which, started at a time when the commercial application of electric traction was unknown, was bound to come to grief, for reasons which we need not stop to discuss, with air propulsion as its *modus operandi*.

Mr. Threlfall is to be congratulated on the energy and perseverance with which he has carried on his self-imposed task during the past four years, and it will not be his fault if the tube now under consideration is not in early operation, and extensions in hand.

On the 11th inst. the *Daily Mail* published a sensational, and technically inaccurate, account of "London's Lost Tunnel." The engines were never increased from 100 to 800 H P. Fancy 800 H P. to drive two or three trucks through the Pneumatic Despatch Company's tube! No wonder the financial results were on the wrong side.

The figures relating to the number of trolleys and weight to be carried are also wholly misleading.

Each electric locomotive is calculated to draw as a maximum, *seven* trolleys, each taking *one* ton, in addition to the weight of the trolley, at a maximum rate of 40 miles an hour.

AMERICAN TELEPHONE PRACTICE.*

Self-induction and Capacity.

By KEMPSTER B. MILLER.

Every insulated conductor is capable of receiving a certain charge when subjected to an electromotive force; for instance, if a metallic plate insulated from all surrounding bodies is connected to one terminal of a battery the other terminal of which is grounded, a certain amount of electricity will flow into the plate until its potential is raised to that of the battery terminal. The plate is then said to be charged, and the amount of electricity held by it determines its capacity. The charge of electricity on the plate will be considered positive or negative, according to whether the positive or negative terminal of the battery, or other charging source, was connected with it.

It is well known that no charge exists by itself—there is always an equal and opposite charge induced by it upon neighbouring bodies. It is also well known that like charges repel each other, while unlike charges attract; that if an uncharged body be brought near a charged body an equal and opposite charge will be induced on the side of the uncharged body which is toward the charged body, and that similarly a charge of the same sign as that on the charged body will be induced on the opposite side of the uncharged body. If now the body which was originally uncharged is connected with the ground, this latter charge, that is, the one of the same sign as the original charge, will be driven to the ground, while the charge of opposite sign will still be attracted by the charge on the first body. The second body will therefore be charged, although it has not been in contact with the first. The action between charges of electricity taking place through an insulating medium is called electrostatic induction. It is found that where two conductors are placed side by side, but insulated from each other, the capacity of each will be greater than if the other were not present. For the purpose of holding charges in this manner the well-known Leyden jars have long been in use. They are usually made by coating a glass jar inside and out with a layer of tin-foil to within a few inches of the top. The outer coating is usually connected with the ground, while the inner coating is connected with a metallic rod approaching it through the mouth of the jar. If the inner coating is connected with a source of electromotive force, a current lasting but an instant will flow into the coating, producing a charge. This charge, which we will say is positive, will attract a nearly equal negative charge to the outer coating, repelling an equal positive charge to the earth, as already described. The amount of charge which the inner coating will receive under these circumstances is very much greater than if the outer coating were not present, and the capacity of the inner coating is therefore much higher than before. A device, such as the Leyden jar, is called a condenser.

The capacity of a condenser is increased as the area of the conducting surface is increased; is increased as the distance between the conductors is diminished, and may be increased or diminished by using different kinds of insulating material between the conductors. The medium separating the conductors is called the dielectric and, as stated above, upon it depends to the greater extent the efficiency of a condenser. Several condensers built exactly alike so far as size of plates and the distance between them is concerned, and using different materials for dielectrics, will be found to have different capacities. This difference is due to a peculiar property possessed to different degrees by different dielectrics and called specific inductive capacity.

The specific inductive capacity of a dielectric is a measure of that quality which enables the dielectric to hold a charge between two conductors, as in a condenser. The specific inductive capacity of air is taken as a standard and is for convenience considered as unity; it is lower than that of any other known substance excepting, perhaps, hydrogen. If two condensers having plates of equal size and distance apart are constructed with dielectrics respectively of air and gutta-percha, it will be found that the condenser having the dielectric of gutta-percha will receive a charge nearly $2\frac{1}{3}$ times as great as the condenser having the dielectric of air. The actual ratio between the two is 2·462, and for this reason the specific inductive capacity of gutta-percha is said to be 2·462. The following table gives the specific inductive capacities of some of the more important insulators:—

Air	1·00	Ebonite	2·284
Glass	3·013	India-rubber	2·220
Shellac	2·74	Paraffin	1·994
Sulphur	2·580	Carbonic acid	1·00036
Gutta-percha	2·462	Hydrogen	0·99967

It is probable that with very rapidly varying electromotive forces, such as are dealt with in telephones, the specific inductive capacities of the various substances would be higher in comparison with air than those indicated by this table.

Specific inductive capacity is a very important consideration in the construction of cables for telephonic purposes. In the construction of these cables it is desirable, as will be shown later, to reduce the capacity of the wires of the cable to as great an extent as possible, and in order to do this the dielectric is, in the best forms of cables, made of dry air to as great an extent as possible. On the other hand, in the construction of condensers it is desired that the capacity may be as great as possible for a given area of plates, and therefore some material other than air is used. Paper saturated with paraffin is perhaps the most commonly used, paraffin having about twice as great a specific inductive capacity as air, and, moreover, lending itself readily to the purposes of insulation. To sum up, the capacity of a condenser varies in direct proportion as the area of its plates, inversely as the square of the distance between the plates, and directly as the specific inductive capacity of the dielectric.

The effect of a condenser bridged across a circuit carrying an alternating current is to absorb a portion of the current as the electromotive force at its terminals increases, and as the electromotive force decreases, to give this current back to the line. Consider such a circuit when the electromotive force active in driving current through it begins to rise. The electromotive force at the condenser terminals will also rise, and current will therefore flow into the condenser. The strength of this current will depend directly upon the rate at which the potential at the terminals of the condenser is changing. When the electromotive force acting in the circuit reaches a maximum, the potential at the condenser terminals will also be a maximum, and will for an instant cease to change. At this point the condenser is fully charged, but as the electromotive force of the line is not changing, no more current flows into the condenser. In other words, the condenser current is zero. As the electromotive force in the line decreases, current will flow out of the condenser and into the line, because the condenser is not

* *American Electrician.*

capable of holding so much charge at the lower potential. The flow of current out of the condenser reaches a maximum when the electromotive force in the line is changing most rapidly, and this occurs when it is passing through zero. From this it will be seen that the condenser current is zero when the electromotive force in the line is a maximum, and is a maximum when the electromotive force in the line is zero. This indicates, as in the case of self-induction, a phase difference of 90°, or a quarter of a cycle. It is not so easy to say whether this phase difference is lagging or leading, but a consideration of the direction of flow of current throughout the cycle will throw some light upon the subject.

At the instant when the current flowing in the line (which is in exact phase with the active electromotive force in the line*) is positive and at a maximum, the condenser current will be zero. As the active electromotive force decreases toward zero, the condenser current increases, but in a different direction—negative—because current is now flowing out of the condenser back to the line. As the active electromotive force reaches zero, the condenser current is at its maximum negative value, and as the active electromotive force reaches its maximum negative value, the condenser current reaches zero. During the next half cycle the condenser current increases to a positive maximum, and decreases to zero, while the active electromotive force passes from a negative maximum to a positive maximum. In other words, while the active electromotive force and therefore the line current with which it is in phase decrease from a positive maximum value to a negative maximum value the condenser current is negative, and while the active electromotive force increases from its negative to its positive maximum value the condenser current is positive. The condenser current, therefore, reaches its zero value, while decreasing, 90° in advance of the same value of the active electromotive force; its maximum negative value, 90° in advance of the maximum negative value of the active electromotive force; and upon investigation it will be found that every value of the condenser current occurs 90° in advance of the corresponding value of the actual line current. The electromotive force which is in phase with the condenser current is called the condenser electromotive force, and is 90° in advance of the electromotive force which is active in driving current through the line. This latter electromotive force, which, as we have said, is in phase with the current flowing in the line, is the resultant of the impressed electromotive force, and the condenser electromotive force, and therefore leads the impressed electromotive force by a certain angular distance.

The current equation for a circuit containing resistance and capacity is, as before,

$$\text{Current} = \frac{\text{Electromotive force}}{\text{Impedance}}.$$

In this case the impedance depends on the ohmic resistance of the circuit and on its capacity, and is equal to the following expression:—

$$\sqrt{\text{R} + \frac{1}{4\pi^2 f^2 c^2}}.$$

Where f is the frequency, as before, R the ohmic resistance, and c the capacity of the condenser in farads. From this the current equation becomes

$$\text{C} = \frac{\text{E}}{\sqrt{\text{R}^2 + \frac{1}{4\pi^2 f^2 c^2}}}.$$

The denominator is the apparent resistance, depending upon the ohmic resistance of the circuit, the capacity and the frequency of alternations. An inspection of this equation will show that as the frequency, f, is increased the impedance or apparent resistance becomes smaller, and this accounts for the fact that a condenser will readily transmit rapidly fluctuating currents, such as voice currents. Evidently the effect of increasing f reduces the second member in the denominator of the equation, and if sufficiently great, this may be neglected, and the equation becomes simply

$$\text{C} = \frac{\text{E}}{\text{R}}.$$

Again, increasing the capacity of the condenser also increases the effective current by reducing the impedance.

Every telephone line possesses electrostatic capacity, and may be considered in the light of a condenser. In the case of a grounded circuit, the line wire takes the part of one plate of the condenser, while the ground and other neighbouring conductors act as the other plate. In metallic circuits the one side of the line acts by electrostatic induction upon the other, and the two together, upon the ground and neighbouring conductors. The capacity of a line, however, differs from that of a condenser in that it is distributed throughout the entire length of a line, while a condenser connected with a line would have all of its capacity at a single point. Capacity, such as that of a line, is termed distributed capacity in order to distinguish it from that possessed by a condenser, which may be termed local capacity. The effect of distributed capacity upon telephone currents may be more readily grasped by imagining a large number of condensers bridged across the two sides of a metallic circuit at frequent intervals. When the electromotive force impressed upon one end of the line increases, a current flows from the source over the line wire and into the condensers, charging them all according to the difference of potential across their terminals.

The difference of potential across the terminals of all the condensers will not be the same, because there is a certain drop, due to the ohmic resistance of the line wire. If the current flows in that direction long enough to charge all of the condensers on the line, then a current will reach the distant end of the line, and if it continues in that direction, will attain its full value, in accordance with Ohm's law. It must be remembered, however, that each condenser is capable of taking a certain charge, and in order to receive this charge, a certain quantity of electricity must flow over the line wire.

The quantity of electricity which flows through a circuit depends upon the strength of the current, and upon the time it is allowed to flow. If the time is insufficient, it will be impossible for enough current to flow through the circuit to charge the condensers up to the potential of the source, and therefore the current at the distant end of the line will not reach its maximum value, and, in fact, may not rise practically above zero. If, therefore, the electromotive force of the source is reversed before sufficient current has time to pass through the line to charge all of the condensers, the current will not reach its full value at the distant end of the line.

It may begin to build up in the opposite direction, and again be stopped on account of the insufficient time to reach its proper value in that direction. The time in which the current in such a circuit will reach a definite portion of its maximum value at the distant end of the line is called the time constant, and if the time represented by one alternation of the electromotive force is smaller than the time constant, the current will not reach that value at the distant end of the circuit, and the transmission will be correspondingly impaired.

The reduction in the actual volume of current transmitted by the effects of distributed capacity is, however, of less importance than the distortion of the wave form. The higher frequencies of current waves corresponding to the higher over-tones are absorbed by the condensers far more readily than the lower frequencies, and, therefore, the waves corresponding to the higher over-tones are reduced to a much greater extent at the distant end of the line than those corresponding to the fundamental and the lower over-tones. This weeds out the upper harmonics, thus tending to destroy the clearness. Capacity, however, acts in still another way to alter the form of the wave. The angle of advance for the higher frequencies is greater than that for the lower, and, therefore, the waves of different frequencies are shifted with respect to their phase relation, thus greatly altering the wave form.

It has been shown that the electromotive force of self-induction lags 90° behind the active electromotive force, while the electromotive force due to capacity is 90° in advance of the active electromotive force. It is not difficult

* The active electromotive force is the resultant of the impressed electromotive force and the condenser electromotive force, and is in phase with the current actually flowing in the line.

to conceive, therefore, that by properly proportioning the self-induction and capacity of a circuit the electromotive force of self-induction may be made to neutralise the electromotive force of capacity, and this result is readily obtained in experimental work.

In this case, even though self-induction and capacity may be present in a circuit to a large degree, the current flowing in the circuit is in exact phase with the impressed electromotive force, and its value is in strict accordance with the ordinary expression of Ohm's law. Unfortunately, however, for long-distance telephony such a balancing of self-induction against capacity can be obtained only for one particular frequency at a time. To thus tune a circuit for one particular frequency would render that circuit capable of transmitting efficiently one particular frequency of vibration, while the requirements of telephony are that all frequencies within the range of the human voice shall be transmitted with equal facility. Again, and unfortunately, it has been found impossible to neutralise distributed capacity with anything but distributed self-induction, and this has not yet been accomplished in practice.

As for trans-oceanic telephony, the high static capacity of the cable has so far proven an insurmountable obstacle. It is impossible to conceive a transmitter capable of forcing such rapid undulations through our present form of cables. Clearly then the solution lies in the betterment of cables, or the substitution of some other transmission medium, rather than the improvement of the instruments themselves.

There can be little doubt that trans-oceanic telephony will finally be accomplished, but the indications are that our knowledge at the present time is not sufficient to cope with the problem.

CORRESPONDENCE.

"Stresses in Steam Engine Shafts for Electric Traction."

Now that the writer of the article on the above has expressed the meaning which he intended to be conveyed by the paragraph to which I took exception, there is, of course, no serious disagreement between us.

It is mostly, as he says, one of terms. I did *not* mean by the "ordinary stress" that corresponding with the current for which the circuit breaker is adjusted. By "ordinary stress" I mean that corresponding with the rated normal full load as generally understood by the manufacturer.

There is no need for me to endeavour to substantiate the 1,000 per cent. rise of torque, as your contributor concedes my point when he says: "If there were no circuit-breaker the braking action might be enormous." Everything depends, as I stated before, on the time lag of the generator and on the machine circuit breakers, and it is just here where, I think, we differ slightly, he assuming that the latter protect the machine absolutely, which I am not so sure of.

Your contributor takes his stand on a possible excess of stress of 100 per cent. above the ordinary not being exceeded; but, even bearing in mind that his "ordinary" stress is taken at from 50 to 150 per cent. above my "normal," I still think he hardly makes a sufficient allowance.

The following suggestions may be offered in support of this view:—

1. On a road on which the service is infrequent, or the grades severe, the *station* load may frequently vary momentarily in regular work to the extent of 100 per cent. above the normal (my normal); and, at the moment of the overload, any one engine may easily get considerably over this due to inequality of division of the load. If the machine circuit breakers were adjusted exactly for this load (100 per cent. above the normal), there would be such frequent openings of the circuit breakers that the station engineers would, I anticipate, soon alter the adjustment. I believe that on the Waterloo and City Railway the machine cut-outs are adjusted for 800 amperes, which is getting on for 140 per cent. above the normal rated output.

2. There can, it seems to me, be a considerable rise of current in the generator, and consequent stress in the shaft (over and above this 140 per cent.) before the circuit breaker acts. Indeed, but for the time lag of the generator itself, I see no reason why there should not be sufficient to shear the shaft, even with the circuit breaker properly adjusted.

I find that, if we could imagine a sudden increase of current sufficient to shear the shaft, this shearing would be performed on a 5-inch shaft, running at 350 revolutions, and transmitting 200 H.P., in roughly ·0007 second; the length under shear being 6 inches. That is to say, in that extremely short interval of time the angle of twist of the fly-wheel would be sufficient to cause shear of the shaft.

I have also made a rough attempt to gauge the time taken by the plunger of an "I.T.E." circuit breaker, before it liberates the catch, and find this to be of the order of ·024 second.

Obviously, therefore, if the generator had *no* time lag the current would easily have had time to shear the shaft before the circuit breaker acted (assuming my figures correct).

Perhaps some of our station engineers may be able to contribute some idea, from actual experience, of the rate of increase of the current, through armature and series coils, when these are short-circuited under an E.M.F. of 500 volts, say, with a 200 KW. set.

With what is virtually a closed secondary of very low resistance (the unlaminated field) the "time constant," as calculated from the dimensions of the magnetic and electric circuits should be reduced several fold.

If Mr. Philip Dawson would give us some particulars as to the numerous accidents which have happened in the United States due to shafts shearing and to faulty circuit breakers, which the remarks in his book and in the lectures before the Institution of Mechanical Engineers (see ELECTRICAL REVIEW, No. 1,045, Vol. 41) suggest, it would probably be very instructive reading.

I must conclude this somewhat lengthy letter with an apology to your contributor for having so imperfectly replied to his questions.

The speed of the shaft he asks for was 350 revolutions.

A. M. Taylor.

September 13th, 1899.

ELECTRICITY AT CRIPPLE CREEK MINES.

THE prevailing idea of a gold mine as something inaccessible, is rather dissipated by an article by J. Tonge in the *Engineering Magazine* on the Cripple Creek district. In that favoured locality the miner can proceed to work in an electric street car. Nowhere else in the world can the gold miner do this. Curiously, however, there are mining districts in effete old England where the coal miner, in all his picturesque many coloured rags, can proceed to his work in an electric street car. This will set him down practically at the very pit's mouth, down which he will be wound by an old fashioned beam engine. There, however, he ceases to emulate the Cripple Creek miner who is wound down electrically, keeps his mines dry by electrical pumps, and uses electric drills. However, both the new and the old world miner have to laugh at all London. Thanks to a County Council which is advised to reject the one practicable method of electric traction, we seem to have said farewell to our hopes of securing in London the facilities enjoyed by the Staffordshire miners.

Cripple Creek is a curious district. Little over 6 square miles in area of hills and valley, and situated over 9,500 feet above the sea, one town, Altman, being placed at an elevation of 10,300 feet, this small area contains upwards of 150 productive gold mines, 15 of which send out over 1,000 tons of ore per month. The gold production in 1891 was about £1,600,000. In 1894 it had risen to nearly £3,000,000, and up to this year's July dividends, the shareholders had aggregated £1,600,000 in joint stock mines alone. A remote mountain pasture in 1891, the district now has a population of 50,000. Steam railroads encircle the area, but do not enter it, and the way to the mines was difficult, or, at least, arduous. This led to the construction of the electric line starting from Cripple Creek town and meandering through the district to Victor. It is a line of curves and grades, climbing to a height of 10,514 feet, or 1,000 feet above its two termini. The round trip takes one hour at 12 miles an hour average. The line is driven by water-power at Lake Moraine, 11,300 feet on Pike's Peak, and electricity is transmitted nine miles to a central distributing station. It is shortly to be extended to Colorado Springs, a distance of 32 miles. The mines of the district being so elevated, the cost of water and fuel was very heavy, and coal was hauled from Canon City coalfield, 30 miles distant and 5,000 feet lower in elevation. As a rule the mines are either naturally dry or have been made so by levels at lower elevations, and local streams are few and small. Water has often cost as

much as fuel, and with the usually inefficient steam plant at a mine power was a very serious item. Obviously the district was eminently suitable for electric power distribution.

In July, 1888, the first electric mining hoist was put into work at Aspen, Colorado, and is still in operation. It was driven by a generator at Hunter Creek. This did other work also, and was of 60 H.P., and later was changed for 125 H.P.

Early in 1893 a 500-H.P. plant was established at Maroon Creek, Aspen. There are to-day at Aspen motors of over 700 H.P., all deriving current from water-driven generators. They have replaced the steam engine and have paved the way for the universal establishment of electric-power plants at the mines in Colorado. The beginning at Cripple Creek was made with the power plants of the Colorado Electric Power Company at Carson City, 30 miles from the creek, and that of the La Bella Mill Water and Power Company at Goldfield, within the district of Cripple Creek itself. In each case power is generated by steam plant, the first transmitting current 27 miles, the second carrying coal 27 miles and transmitting current from a comparatively local station. The former company has a capital of £100,000 and a power of 2,250 H.P. It has worked since 1898. Current is generated at 500, transformed to 20,000 volts, and transmitted by three bare No. 3 copper wires arranged in a triangle on 30-foot poles, one wire being at the top. A telephone circuit of two wires is carried on the same poles. Distribution is made at 500 volts from step-down stations on Gold Hill and Battle Mountain.

Customers for 1,200 H.P. are already on the books, consuming each from 75 to 150 H.P. for large consumers, and down to 5 H.P. for small consumers; a hoist of 15 H.P. will serve a depth of 450 feet; 30 H.P. will serve down to 800 feet, and 100 H.P. may be used for the greater depths. The company leases to a prospector a small hoist, and a small prospector can put all his capital into development. He can purchase as soon as he finds pay streak. The minimum rent of 5 H.P. is £10 per month, including hire and supply. This may seem heavy, but it could be done in London. We are informed by a recent owner of a small steam plant that for a power much less than would be afforded by 5 H.P. of electric motors, his steam power cost, directly and indirectly, at least £300 per annum, and we know of a large printing office in America where the use of motors to each machine saves seven-eighths the power used in similar electrically-driven offices where shafting is employed, and one large motor. Yet the rated motor power of the multiple motor office is double that of the single motor offices. This simply goes towards proving that it is what is not used that constitutes the economy to be sought in electric driving. The Colorado Company rents out in the way described £12,000 worth of machinery. The La Bella Company has a capacity of 3,000 H.P., or 2,250 electric and 750 in compressed air; has 10 miles of underground air mains from its station to various mines, some of them two miles distant, while electricity is transmitted five miles. The power station is thoroughly modern. Coal is dumped into bins direct from cars and mechanically fed to the fires. Ashes are mechanically removed. Condensing engines are used. Being 10,000 feet above the sea, cooling towers are used to save water, the first application of the cooling tower in the State. The vacuum cannot attain 20 inches, for the barometer only stands at 20 inches of mercury.

The triphase system of distribution is used at 6,400 volts directly generated, but at the mines there are step-down transformers to 110 and 440 volts for light and motors respectively. Only 2 per cent. is lost between the power house and a 300-H.P. motor one mile distant. Lights can be operated from the motor circuit without flicker or any indication of fluctuating load. The chief uses of electrical power are hoisting and air compressing for drills, the latter being the chief power consumer at most mines.

The saving effected is estimated at from 15 to 50 per cent., according to location and circumstances, irrespective of reduced wage account, of greater reliability and convenience, and freedom from stoppage by frost. The use of electricity has thus rendered possible the use of lower grade ore, hitherto not available, this being unprofitable at the high rates for power. We commend this brief history of electrical power distribution to the hesitating and uninformed men who seem to fill so many of our local councils. Their one aim seems to be to make tours of inspection to see things they do not understand, and they return just as wise as they set out, and all the more confused as to the system they should adopt. If they would accept once for all that electrical distribution is *un fait accompli*, just as much as steam power, they might get something done. The sight presented at this end of the 19th century by some of England's local authorities is indeed pitiable.

BUSINESS NOTICES, &c.

Annual Outing.—On Saturday, September 9th, the employés of the British Thomson-Houston Company, Limited, to the number of 65, went to Bournemouth for their third annual outing. On arrival, the party adjourned to the handsome dining room of the Grand Hotel, where a sumptuous repast was served. Mr. Ireland, of the supply department, presided in the absence of Mr. Monks, managing director. Mr. Ireland in his remarks said, among other things, that the B.T.H. would shortly put a cricket team in the field. We are also pleased to note that it is proposed to have some B.T.H. smoking concerts this winter. After the banquet the party assembled on the lawns of the Grand Hotel, where they were photographed.

Book Received.—"Télégraphie et Téléphonie," by J. Pierart. New edition. Brussels: Hayez, editeur.

Electrical Wares Exported.

Week ending Sept. 13th, 1898.		Week ending Sept. 12th, 1899.	
Adelaide	£13	Adelaide. Teleg. wire	£767
,, Teleg. mat.	194	Amsterdam	93
Alexandria	16	Antwerp	38
Amsterdam	51	Auckland	75
Boulogne	140	Bombay	81
Calcutta	313	Bordeaux	10
Cape Town	242	Buenos Ayres	50
Colombo	238	,, ,, Teleg. mat.	125
Copenhagen	140	Bushire	25
Durban	943	Calcutta	257
Gothenburg	114	Cape Town	529
Hamburg	18	Channel Islands	17
Helsingfors	27	Chinde. Teleg. mat.	565
Hong Kong	320	Christchurch. Teleg. wire	124
Madeira	124	Colombo	44
Malaga	62	Copenhagen. Teleg. wire	53
Melbourne	1,172	Durban	94
Ostend	8	Flushing	124
Port Chalmers	14	Gibraltar	7
Rio Janeiro. Teleg. mat.	875	Hamburg. Teleg. mat.	65
Rosario. Teleg. mat.	154	Hong Kong. Teleg. mat.	41
St. Petersburg	160	Ibrail	15
Stockholm. Teleg. wire	105	Madras. Teleph. mat.	181
Sydney	864	Melbourne	293
,, Teleg. cable	370	Ostend	123
Tientsin. Teleg. mat.	65	Perth	41
Wellington	882	Port Said	10
Yokohama. Teleph. mat.	302	Rotterdam	150
		,, Teleg. wire	57
		Shanghai. Teleg. wire	116
		Singapore	543
		,, Teleg. mat.	50
		Stockholm	74
		,, Teleg. wire	921
		Sydney	599
		Tientsin	12
		,, Teleg. mat.	73
		Wellington	902
		Yokohama	218
Total	£7,366	Total	£6,689

Foreign Goods Transhipped.

Sydney. Elec. light fittings. Value £23

The American Electrical Trade.—The *Electrical World and Engineer* says that a large quantity of new work is opening up in the electrical field as the fall season begins, giving promise of a very active winter. There would be even more if the prices of steel and iron and copper had not run to such an inordinate height, but it begins to look pretty certain that copper will have to come off its lofty perch and that electrical industries will not much longer be hampered and held back by the cost of their raw materials. It is hard to tell just how much new business is checked in this way, but the percentage is definite. In some respects, the "going slow" has done no harm, but has given the electrical factories a chance to get belated orders cleaned up, and a fair preparation made for future contracts.

Bankruptcy Proceedings.—A receiving order has been made in the case of J. Stewart Edwards, electrical engineer, Moorgate Street, E.C. The first meeting and public examination will take place on September 19th and October 18th respectively, at Bankruptcy Buildings, W.C.

In *re* the petition in bankruptcy of Mr. S. F. Walker, carrying on business at Severn Road, Cardiff, as electrical engineer, under the name of "Sydney F. Walker & Co.," the first meeting of creditors was held on Monday at the offices of Mr. George David, the Cardiff official receiver. Debtor attributed his failure to "want of capital and illness in August, September, and October, 1898," and returned his liabilities at £2,729, of which £1,923 7s. 10d. is expected to rank for dividend; the deficiency is £1,862 16s. 11d. According to the observations of the Official Receiver, the debtor commenced business at Nottingham in 1876, with a capital of £500. In 1882 he entered into partnership with a Mr. F. G. Oliver. The business was then extended to Nottingham, Cardiff, and Newcastle, and it was carried on jointly for seven years, when the partnership was mutually dissolved, Mr. Oliver paying the sum of £1,000 and Mr. Walker taking over the whole of the assets and liabilities. The debtor had 23 apprentices when he filed his petition, and preferential claims for over £650 are likely to be made for the return of premiums. Mr. C. E. Dovey was appointed trustee, and a committee of inspection was nominated.

Liquidations, Dissolutions, &c.—Messrs. W. H. Clegg and C. D. Falcke (Birmingham Installation Company), electrical engineers, have dissolved partnership, and Mr. Falcke will continue the business under the same name and will attend to debts, &c.

The Railways Electric Supply Syndicate, Limited, has decided to wind up voluntarily, and Mr. F. B. Townsend, of 24, Queen Victoria Street, E.C., has been appointed liquidator.

Creditors of Nernst Lamp, Limited, are required to send their names and the usual particulars to the liquidator, Mr. W. Chaplin, Dashwood House, E.C., by October 21st.

Bristol.—Messrs. Gilbert J. Lloyd & Co., of Bristol, who are very busy in that neighbourhood, have recently received a contract for an installation for Messrs. C. Baylor & Co.'s new factory at Easton for 400 lights. Current will be supplied from two dynamos. The wiring is being carried out in duplicate throughout the building, so that if one machine fails, every alternate lamp is extinguished only. Wiring is being done on the 5-ampere distribution system.

Catalogues, &c.—Messrs. Mather & Platt, Limited, have in circulation a very nicely printed leaflet illustrating one of their multipolar dynamos coupled direct to a vertical engine, also giving general particulars and dimensions of same.

We have received also from the same company a copy of a small illustrated pamphlet describing the marine type of engine which they have manufactured in considerable numbers during past years. The standard sizes embody all the improvements in design and construction, which several years of experience and careful observation have demonstrated as advantageous. The engines are specially suited for various classes of work, and being of an open type, all parts are easy of access and supervision; they have a low steam consumption and are arranged to run at a moderate rate of speed. A special type of electrical machine has been constructed for mounting upon the extended bed of this class of engine, the generator being driven direct from the engine, and running at the same rate of speed. Large numbers of these combined plants are now at work in various parts of the world and giving very great satisfaction. In the latter portion of the catalogue, is found a description of a few small sizes of enclosed engines, which have been designed to meet the requirements of customers. All particulars of sizes, weights, and overall dimensions are fully given. The list contains some good illustrations.

The Stilwell-Bierce and Smith-Vaile Company of St. Louis send us a list of the Victor atmospheric water cooling towers and condensers.

Mr. C. R. Heap, of Victoria Street, S.W., sends us a mounted and varnished sheet of illustrations for the wall, showing some of the standard types of C. & C. and Wagner machines.

Claim against India-Rubber Company.—An application came before Mr. Justice Kenny at Dublin last week in the case of William Cameron *v.* India-Rubber, Gutta-Percha and Telegraph Works Company. Although the case can hardly be called an electrical one, it is of interest to mention its character. Plaintiff, of Newry, claimed damages for breach of contract to manufacture and sell a pneumatic shin pad, and to pay the plaintiff a royalty of 10 per cent. The amount of the claim was £50,000, this being arrived at by calculating that there are a million football players, and each pad would sell at 4s.!

Connolly v. Lovelock.—At the Shoreditch County Court, on 25th ult., this interpleader matter came before Judge French. Mr. Alec. Neilson appeared on behalf of the plaintiffs, and submitted the claimant to a stiff cross-examination. This elicited the fact that the claimant was the father of the defendant Lovelock, and he had permitted the defendants to use his works when they had any jobs requiring a big lathe or machinery. He swore that he had nothing to do with Lovelock, Seabourne & Lee, and that he was not, and never had been, a partner in that firm, and, moreover, that he carried on a different kind of engineering business which had nothing to do with electricity, consequently he could not have had the benefit of the goods. He knew nothing about 8, Jeffery's Square, and had only been there since this action was commenced. The Judge, in the absence of any evidence connecting J. F. Lovelock with the defendant firm, consequently found for the claimant with costs.

Deed of Assignment.—Notice is given to creditors of S. B. Apostoloff, of 5, Fenchurch Street, E.C., to send particulars of their claims to the trustee on or before October 15th next. For further information, see our business columns.

Incandescent Lamps.—Messrs. Philips & Co., of Eindhoven (Holland), who are represented in the United Kingdom by Mr. G. Braulik, send us a copy of their catalogue of incandescent lamps. We understand that the firm's works have been largely extended recently, and a first-class staff of 450 men, including eminent technical men, is engaged at the works, the buildings of which now cover 4,500 square yards Messrs. Philips claim that high class quality and low price have built up the large lamp business which they are now conducting. Lamps of 15,000 C.P. are turned out daily. The firm has just brought out a new high voltage lamp with two short unsupported spiral filaments. It is said to be quite new in construction and there is a good demand for it. A prominent feature of Messrs. Philips's business is the manufacture of special lamps for illumination purposes, for which a new lamp has been recently introduced. The method of manufacture consists of taking a tubular lamp with bayonet cap so made that it is possible to screw a coloured bulb directly over the lamp without interfering with the shadeholder, &c. It is therefore claimed that they may be used for theatre and saloon lighting and garden illumination without interfering with the Bohemian glassware or shadeholders. The catalogue before us contains illustrations of incandescent lamps of all shapes and sizes, fancy and otherwise.

Ross v. National Telephone Company.—In the cause list for the Vacation Court at its sitting on Wednesday (6th inst.) A. Ross *v.* The National Telephone Company, Limited, and T. K. Ross *v.* The National Telephone Company, Limited—which were both motions for injunctions to restrain trespass on plaintiffs' land—stood for hearing before Mr. Justice Cozens-Hardy. Counsel, however, intimated that the matter had been settled on terms between the parties and there would be no order.

Soldering Paste.—Messrs. Beanland, Perkin & Co., of Leeds, send us a sample of Burnley's soldering paste, for which they are the sole English agents. This preparation is in very general use in the United States. Messrs. Beanland are supplying it regularly to prominent electrical firms in this country, including Messrs. Johnson & Phillips, Siemens Bros. & Co., and Mather & Platt, &c. Small samples will be sent upon application.

Trade Announcements.—The firm of Julius Sax & Co., Limited, having gone into voluntary liquidation, we have received notice that Messrs. E. Bulstrode (general manager), Thos. Wilson (accountant), E. Buhler (chief engineer), W. Krause (second engineer), and John Plumb (manager of installation department), being the heads of the various departments named, have formed themselves into a syndicate to carry on the business of electrical engineers and electric light contractors (the Saxon Electrical Engineering Company) at Gervase Works, Gervase Street, Old Kent Road, S.E., assisted by several of the late employés of the old company, and working on the same lines.

Messrs. Boulton & Wade, patent agents, Hatton Garden, have taken into partnership Messrs. B. E. Dunbar Kilburn, M.A., and W. J. Tennant, A.M.I.Mech.E. The firm will in future be known as Boulton, Wade & Kilburn.

Messrs. Chamberlain & Hookham's London testing station and depôt at 6, Cecil Court, has been removed to Messrs. Venner & Co.'s new premises at 6, Old Queen Street.

Wiring Contracts.—The British Electric Installation and Maintenance Company, of Blackheath, have secured the contract for lighting the extensive premises of Messrs. Chiesmann Bros., drapers, and furnishing warehousemen, of High Street, Lewisham. They have also received the contract for the lighting of the Parish Church of Lee (St. Margarets).

ELECTRIC LIGHTING NOTES.

Aberdeen.—There is a deficit of £203 on the first seven months of the current year; the output during that time has increased 36 per cent. It is anticipated that the deficit will be annulled by the end of the year.

Mr. Bell, the electrical engineer, has issued a circular to the electricity consumers, stating that when anyone wishes to use a large number of lamps for a special display, he may, on giving 24 hours' notice, have his demand indicator cut out of action, so as not to increase the price charged for the whole supply for the half-year, provided that this does not occur oftener than once a month. We commend this very reasonable arrangement to the notice of supply engineers. It is a small matter, but may obviate much dissatisfaction.

Accrington.—The Board of Trade has decided to allow the Corporation's provisional order to remain operative, seeing that steps are being taken to provide electricity works.

Bristol.—At the Bristol City Council on Tuesday afternoon, Mr. George Pearson moved the adoption of a report from the Electrical Committee recommending the purchase of over nine acres of land for a new generating station, the rapid progress of the demand for electricity having almost exhausted the capabilities of the site already in use. The proposal excited some surprise in Bristol, where, during the recent controversy with the tramway company, so much had been heard of the advantages of combining electrical and power stations. The tramway company's power house is being erected close to the civic electrical works, but the new Corporation station now proposed is in another part of Bristol—perhaps three-quarters of a mile from the existing works, and on the south-eastern edge of Bristol. The explanation for the new proposal was that the progress of the electrical undertaking had greatly exceeded the estimate formed at the time when it was established, and the capacity of the works at Temple Backs, although increased by the addition of adjoining land, is insufficient to supply more than the present demand, while the proposed extensions of the land recently sanctioned will not suffice for more than one year's additional growth. The committee found it, therefore, necessary to prepare for a considerable extension of the undertaking. They failed to find land in the neighbourhood at a price they could recommend the Council to pay, and ultimately selected a site at St. Philips Marsh, costing roundly £15,000. The property has good approach from road, water and rail, and Mr. Pearson explained that it would permit an extension of business 10 times as great as that already done. In commenting on the position in which the committee found themselves, Mr. Pearson said the committee commenced in 1893 in a very small way with 16,000 lamps. In March, 1899, their lamps numbered 68,000, and at present the aggregate was 74,484. They commenced by selling 300,000 units in the year, and last year the sale amounted to 1,362,000 units. The revenue grew from £6,624 in the first year completed to £26,233 last year. With the growth of revenue and output the cost of production had decreased from about 4½d. to not quite 2½d. The profits at first—if a Hibernianism would be allowed—were a loss. The profits last year carried to the net revenue account were £12,630, from which had to be paid interest and sinking fund. It was said that it was improper for a municipal authority to talk of profits until interest and sinking fund had been met. He dissented from that view. No one would dream of saying a public company must not speak of its profits until it had paid its debenture interest and dividends on its shares. He considered the profits they might legitimately consider as profits were what they transferred from the credit of the general revenue account to the net revenue account. They had made a profit notwithstanding a reduction in the cost to private consumers and for public lighting. It showed they had got hold of a good and a growing undertaking, and the growth justified the large proposal he asked the Council to adopt. If they did not hand over actual cash to the city they were benefiting the citizens by reducing the cost. The new site would be equal to supplying 800,000 lamps, or rather more than the total number of gas lights in the city. The site would have an advantage compared with the former one that piling would be less expensive and a river wall would not have to be built. There was the important disadvantage—a division of their work and the cost of working two establishments instead of one. He had asked their engineer what he suggested, and the engineer said the best method

would be to use the present site for the day load, their power and their public lighting. They would want three shifts as at present. He would propose to use the new station to supply their heavy load in times of pressure, and as a stand-by in case of breakdown at the older station, and for that purpose one shift only would be needed. They had proceeded so far in the extension of their mains very much on the principle of supply and demand for the moment, but now their business was getting so big they ought not to proceed on such haphazard lines, and they should lay down for themselves—though they might not carry out the works at once—certain lines on which they would proceed. As to the cost of current, it would be their duty to see if they could not at no distant date reduce the price of public lighting. They had made mistakes, no doubt, but when they had done a stupid thing they thought it best not to advertise the fact, and he should not, therefore, take the Council into his confidence on that matter. He would, however, say they hoped to see the cost of production considerably reduced, their coal bill reduced, and their output increased.—During the discussion on the report, an appeal was made to the Electrical Committee by members of the Libraries Committee to light the libraries with electricity at a lower cost. Mr. Pearson replied that if the electric lighting of the libraries cost more than gas lighting, there must be waste somewhere. He had the light in his own house, and he had more lamps than ever he had, and his last bill was less than his last gas bill. The Council adopted the report.

Messrs. Mindham & Co., of the Western Electrical Works, have secured the contract for lighting St. Stephen's Church, one of the oldest historic churches of this city. They have also in hand several important electric lighting contracts, including a large new Nurse's Home in connection with the Bristol Royal Infirmary; a large new suite of offices, and several steamships that are now running from this port.

Bucksburn.—A meeting of the ratepayers was held last week to consider the electric lighting scheme for the village, proposed by Messrs. P. C. Middleton & Co., electricians, Aberdeen. The firm offered to pay £50 per annum for the surplus water at present running from the turbines of the Waterton district supply, as well as to erect a house for the official who would have charge of the lighting station, and to pay his salary. They were also prepared to supply 60 street lamps of 16 c.p. at 25s. 6d. each per annum. The light would be provided for nine months of the year, and the contract between the district authorities and the electrical engineers would be binding for 21 years. A resolution was unanimously passed to take the necessary steps for forming a special lighting district.

Cheltenham.—Residents in Cleeve Hill want a supply of electric current. The Council is willing to undertake this when powers have been obtained.

Chorley.—Messrs. Lacey, Clirehugh & Sillar have been requested to report to the Council on the subjects of electric lighting, traction, and refuse destructor.

Colchester.—The Local Government Board has sanctioned the proposed loan of £6,500 for electric lighting purposes, the money to be repaid in 25 years.

Coventry.—The electric lighting of the new extensions to the cycle works of Messrs. Rudge Whitworth, Limited, is being carried out by Messrs. Ellis & Ward, electrical engineers, of Birmingham. The plant consists of upwards of 200 incandescent lamps and several arc lamps. Arrangements are also being made to supply the lift, which is one of Messrs. Waygood's, with electric power.

Darlington.—The Town Council has received sanction from the Local Government Board to the borrowing of the sum of £25,940 for electric lighting purposes, such sum to be repaid within a period of 25 years. The question of the town supplying electric power to the tramway is being considered.

Darwen.—We hear that the electricity works have been so far completed as to allow a supply of current to be given for private lighting. Street lighting will commence in about 10 days or a fortnight.

Dawlish.—The District Council has accepted Messrs. Taylor & Field's offer to report on the electric lighting of the town for 20 guineas.

Dewsbury.—The Local Government Board has intimated to the Town Council that before sanction can be given to the borrowing of £9,060 for the purposes of electric lighting, it will be necessary to obtain the permission of the Board of Trade to the alteration of the standard pressure on the mains.

Dorchester.—The Edmundson Electricity Corporation having given notice to the Council of their intention to apply for a provisional order to light the town, it was decided to oppose on the grounds that the Town Council intended introducing the electric light into the borough in the near future.

Dundalk.—Representatives of the Irish Development Syndicate have had a private interview with the Dundalk Urban Council with reference to the terms of transfer of the electric lighting powers of the Council to the Electric Tramways Company. The proposal to construct and work a system of electric trams for the town and its seaside neighbour Blackrock, and to combine with this undertaking the electric lighting of the town, was made a considerable time ago, but difficulties arose as to the terms on which the provisional order obtained by the Town Commissioners should be transferred. It is now stated that the basis of an agreement has been arrived at, and that work will shortly be commenced on the construction of the tramlines and works.

Erith.—The Urban District Council have instructed Mr. W. C. C. Hawtayne to prepare plans for the generating plants and mains, they having decided to take steps to establish a municipal electricity supply for the district upon the basis of Mr. Hawtayne's scheme, dated June, 1898.

Farnworth.—Messrs. Lacey, Clirehugh & Sillar have received instructions from the Urban District Council to proceed with the scheme for lighting and traction.

Festiniog.—A special meeting was held last week to consider the desirability of lighting the district by electricity. After some discussion, it was resolved that the Council apply to the Board of Trade next session for a provisional order with the view of carrying out electrical supply works for the district. Mr. T. J. Warden Stevens was appointed out of seven candidates to prepare a report upon the matter.

Fort William.—The Electric Light Company's annual report has just been published, and is of an encouraging nature. During the past year the electricity supply has been extended to the villages of Banavie and Corpach. By arrangement with the Burgh Commissioners the company has acquired the use of the surplus water supply of the town, and has erected an additional turbine.

Frimley.—The District Council has appointed Mr. F. H. Medhurst to report on the subject of electric lighting.

Gillingham.—The District Council has resolved to enter into an agreement with Mr. Jasper for the supply of electric light to arc lamps in the public street at 2½d. per Board of Trade unit; the lights will be turned out at 11 o'clock.

Grimsby.—The Public Lighting Committee has issued invitations for laying the foundation stone of the new electricity works by Alderman Dobson, on Thursday, October 5th, at 2 30 p.m.

Hales Owen.—The District Council approached the Gas Company with a view to purchase; the company demurred to the proposals, and now the Council has invited the British Electric Traction Company and the Midland Electric Power Distribution Company to discuss the question of taking over the Council's powers for electricity supply.

Harrogate.—The Gas and Electric Lighting Committee have resolved that from January 1st next the rate of charges to consumers of electric light be as follows:—Under 15,000 units per annum, on the demand indicator system, at 6d. per unit for the first 1½ hours, and 3d. per unit afterwards; over 15,000 units per annum, on the demand indicator system, at 6d. per unit for the first hour, and 2d. per unit afterwards.

Heywood.—The Electric Light Sub-committee advises that Mr. W. P. Adams, of London, be appointed consulting electrical engineer, and that his scheme be adopted. The scheme provides for the erection of works on the new town's yard site in Hind Hill Street. The works are to be capable of meeting the estimated demand for the first two years and are to be so arranged as to be easily extended. They will also be so arranged as to enable the works to supply power for traction.

Ilford.—Colonel A. C. Smith, R.E., held a Local Government Board inquiry at Ilford last week into the Council's application for sanction to borrow £4,000 for site for depôt, electric lighting, and tramway station. There was no opposition.

Inverness.—The proposal to utilise water-power from the Caledonian Canal for electric lighting purposes has fallen through. The Council has decided to adopt steam-power, and has appointed Mr. Craven, Edinburgh, to draw up plans and specifications for a suitable scheme.

Lerwick.—At the monthly meeting of the Burgh Commissioners last week, a report by Mr. R. F. Yorke, electrical engineer, Glasgow, was submitted as to the proposed introduction of the electric light into Lerwick. Mr. Yorke finds that the Sandy Loch, from which the water supply of the town is at present drawn, contains sufficient surplus water for motive power purposes, and would give 80 H.P. for six hours per day, the gross fall being 220 feet. He recommends that a turbine house should be built at the Loch Clickimin, which would involve the laying of a 16-inch pipe from the Sandy Loch to that point, a distance of about 2,000 yards. In order to avoid drawing too largely on the Sandy Loch during the summer time, the engineer proposes to utilise a smaller loch near to it, by which means an additional storage would be obtained of 6 feet over the whole area, which he estimates would be capable of giving sufficient water in summer for, say, a period of three months. The electric current will be conveyed from the turbines to the accumulator house at Union Street. The total cost of the undertaking is estimated at £9,260, and the working expenses, including interest and sinking fund, at £967. The revenue from the public and private lighting, charging 6d. per unit, is estimated at £1,720, leaving an apparent surplus of about £760 per annum. The present price of gas in Lerwick is 7s. 6d. per 1,000 feet. Before discussion, it was decided to circulate the report among the commissioners prior to next monthly meeting.

Llanrwst.—At Llanrwst Urban Council a letter has been received from the Electricity Supply Company, regretting that owing to inability to get delivery of required material, they were unable to give light by the specified date, but stating that they were doing all they could to give the light as early as possible, and should the delay inconvenience the Council, promising to "meet" the Council with a corresponding reduction in price.

London.—At the St. George's-in-the-East Vestry last week, a letter was read from the County of London Company intimating that they were going to commence laying the mains for the electric lighting in the main streets in the district.

Manchester. — The Electric Light Committee is to borrow £5,000 for transformers, meters, &c., required during the next 12 months.

Merionethshire.—At Dolgelley, the county town of Merioneth, a decided move is being taken to light the town by electricity, and a comprehensive scheme is likely to be placed before the next meeting of the District Council. It is stated that the Council now pay £150 per half-year for lighting, and that they can borrow £2,500, and only pay £150 in interest.

Nenagh.—The Town Commissioners are considering the question of electricity supply. The feeling of the town is entirely in favour of electric lighting, the prevailing idea being that neither the municipal body nor private consumers are being favourably treated by the gas company.

Newport.—Mr. H. M. Taylor, the assistant electrical engineer, having resigned his appointment, the Committee met recently to consider the question of rearranging the electrical staff. It transpired that the working of additional plant now being laid down would necessitate further assistance. It was resolved not to fill the vacancy caused by Mr. Taylor's resignation, but to appoint two additional electricians at a salary not exceeding £2 per week each, and to increase the salary of Mr. C. D. Copland, the borough electrical engineer, from £225 to £300 per annum. At a subsequent meeting, the chairman, Alderman John Moses, said that he could not be a party to this arrangement, as it would throw increased responsibility on him, and he therefore resigned his position.—The borough electrical engineer submitted his usual report upon the condition of the plant and machinery. A comparison of the plant with the number of lights showed the plant to be overloaded. The office manager submitted his report as to the progress of the business for the month of July, based upon the number of units generated, showing a satisfactory rate of increase. He also presented a report of his canvass during the past month, from which it appeared that he had obtained orders for new connections equivalent to 278 lamps, bringing the total connected and on order up to 30,380 8-c.p. lamps. The question of reducing the charges for electric energy for motive power so as to meet the large consumption required by Messrs. Griffiths & Sons (clothiers and manufacturers), who intend to put down additional motors, was considered. The present charge is 2d. per unit for a consumption of 3,000 units per quarter. It is understood that Messrs. Griffiths would require about 7,000 units per quarter. It was resolved that the scale be extended so that the charge to all consumers shall be 1½d. per unit for a consumption of 3,000 units per quarter and upwards, provided that Messrs. Griffiths will enter into an agreement to take the energy required for the additional plant they are about to lay down. The station emergency plant is shortly to be sold for £750. As it is impossible to make two of the underground sub-stations watertight, they are to be rebuilt above ground.

Nottingham.—The net revenue of the electrical department, after payment of all charges, was for the past year £3,576. The total profit for the year on an income of £12,847 was £7,776 2s. 4d., but this was subject to the deduction of £4,200 for the contribution to the sinking fund and for interest on loans, &c.

Oldham.—Smoke nuisance from the Corporation electricity works gave rise to a brief discussion at a meeting of the Sanitary Committee.

Paisley.—The electricity works was formally opened on Tuesday last week. The capacity of the works is at present 1,000 H.P., but tenders for additional machinery are to be invited shortly. The total expenditure, so far, has been £53,000. Mr. Francis Teague, formerly of Coatbridge, is in charge of the work, which has been carried out under his supervision.

Penmaenmawr.—At Penmaenmawr the Urban District Council has received a letter from a firm of Worcester electrical engineers, suggesting that the district is particularly well placed and situated for electric lighting. The town water supply could be used for producing the power, and so the streets could be lighted without cost, and a revenue would probably accrue for a reduction of the rates. The matter has been referred to Committee.

Plymouth.—The opening of the electricity works in Plymouth, and the formal installation of the electric light and tramway, have been set down for the 25th inst.

Rochdale.—The Town Council has decided to borrow £30,000 from the Public Works Loan Commissioners for the purpose of the electric lighting in the borough.

St. Pancras.—The Electricity and Public Lighting Committee informed the Vestry on Wednesday of having accepted numerous fresh applications for current. Dr. Walter Smith, chairman of the committee, explained that the requirements of the new customers were equivalent to 500 amperes, thus showing that the undertaking was progressing rapidly. On the recommendation of the committee, the Vestry resolved to apply to the Board of Trade for a license under Section 3 of the Electric Lighting Act, 1882, to supply electricity in Brecknock and York Roads in accordance with the consent given by the Islington Vestry, and to convene a special meeting of the Vestry to pass the necessary resolution in regard to the matter. The Vestry sanctioned an expenditure of £1,661 on laying new mains, accepted the resignation of Mr. R. Minchin, one of the electricians at the Regent's Park station, and granted him a testimonial.

Sale.—The Town Council has rejected a proposal to lay down a municipal installation, and having read Mr. Charles Hopkinson's report, has resolved to approach the Manchester Corporation and the Altrincham Electric Supply Company, with a view to obtaining a supply of electricity in bulk at 3d. per unit.

Ventnor.—The Works Committee on 4th inst. recommended that the District Council should accept the tender of the electric light company for lighting the whole district, at the annual rate of £15 per arc lamp and £2 10s. per incandescent lamp, £707 10s. altogether. The Council asked for an alternative scheme omitting the arc lamps.

Walthamstow.—The Local Government Board has sanctioned the Council's £5,500 loan for the electrical wiring of houses in the district.

Warrington.—The Council is making application to the Local Government Board for sanction to a £44,966 loan for electric lighting.

Welsh Quarry Districts.—At Festiniog (the capital of the Welsh quarry trade) the District Council have decided to apply to the Board of Trade next session for a provisional order to light the district with electricity. Some of the works in the district already make use of the light.

West Glamorgan.—Arrangements are understood to be in progress for lighting Clydach, a populous district in West Glamorgan, by electricity.

Whitby.—The Council has adopted an electric lighting scheme drawn up by Messrs. Preece and Cardew, the total expenditure being £18,500. This scheme was adopted in preference to a £26,000 one.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackpool.—Last week the Council adopted the recommendation of the Electric Lighting and Tramways Committee that the tender of the Barrow Hematite Steel Company, Limited, for the supply of steel rails and fishplates required in the construction of the tramways through Claremont Park be accepted; also the tender of the British Thomson-Houston Company, Limited, for the electrical equipment (except the sand blowing) of the 10 new tramcars now in course of construction. Alderman Brodie, in moving resolutions to this effect last week, referred to the delay in certain work, and apologised for the unfinished state of the trolley heads. It was the difficulty experienced in obtaining materials that caused the delay in the progress of the tramways. They had commenced the overhead system six months before they should have done, but it had been beneficial to the town. It was very gratifying to find that their takings were £4,000 more than they were in the corresponding period of last year. There was every reason to believe that if they had double lines they would do a great deal more on the front. They were told that they did not want any more power, though they were now driving 30 cars by the overhead system against 18 by the conduit system. They instructed Mr. Qain to get out a scheme for going round Marton. They should want more power then, but it would be well worth the money. It would be advisable to take into consideration the question of 1d. stages for next year. The Claremont Park tramways will cost about £18,000.

Boston.—The British Electric Traction Company has written to the Council with reference to the establishment of a service of electric tramways from the Sleaford Road to the Wainfleet Road, or to the Dock, and the letter has been referred to the Paving and Lighting Committee for consideration.

Burnley.—The Tramways Committee has recommended the Town Council to seek in the next session of Parliament the requisite powers to convert the existing tramway within the borough, after its acquisition by them next year, into a double line, as far as practicable, and to include powers to construct tramways in the Burnley Wood district, Manchester Road district, and Accrington Road (with a view to an extension to Lowerhouse).

Dalmuir.—The Glasgow Corporation is considering the advisability of extending the tramway to Dalmuir.

Darwen.—The Tramways Committee has decided to order 10 cars, five from each of two firms. The cars will in many respects be similar to the Blackburn cars, and will be run under the management of the Blackburn Committee. The Committee thought that formed a fair basis, which would endure until the cars were electrically equipped, and after that they would have to make a permanent arrangement. It was estimated that the completion of the line would take place in about 12 months.

Failsworth.—The Manchester Corporation has advised the District Council that the latter would shortly have to give notice to the Manchester Carriage and Tramways Company for the purchase of the lines within the district. The chairman said it was for that Council to give notice, and carry out the transaction; but the Manchester Corporation would be the real purchasers, as they had an agreement to work the trams after the conclusion of the transaction. A special meeting will be held to consider the matter.

Grimsby.—The Town Council has decided to adopt an agreement with the Great Grimsby Streets Tramways Company, whereby the present lease to the company has been extended for 21 years. The agreement contained conditions *re* extensions of the line, and supplying of electrical power by the Corporation to the company.

Hungary.—The Raab-Oudenburg-Ebenfurth Railway authorities are about to carry out some trials of accumulator traction on their line between Kleinzell and Esterhaza.

Isle of Man.—The Tramways Company is still going ahead; a turbine is to be put down at Laxey to supply power to the line during the winter season, and also to assist in the summer. It is anticipated that a great economy will be effected in this way. A deputation from Belfast Corporation visited the island last week and inspected the whole of the tramways.

Limerick.—The city engineer has presented a report to the Corporation on the proposed electric tramway scheme, in which he points out that the promoters have made no offer of wayleave, whereas in Belfast the company pays £4.000 a year, and in Dublin £500 per mile, or a minimum of £10,000 per annum; in Cork, however, no charge is made. The engineer enumerates various conditions, which should, in his opinion, be imposed on the company, one of which—that the latter, if called upon by the Council, must introduce any new system of electric traction instead of the then existing system—appears to us to be unnecessary and unreasonable.

Liverpool.—At last week's City Council meeting the Electric Power and Lighting Committee recommended the Council to enter into a contract with Messrs. Willans & Robinson for the supply for the Lister Drive and Cobbs Quarry Stations of four 3-V triple expansion engines, each coupled to a multipolar dynamo of Siemens' make, for the sum of £6,939 each set, and three 3-H.P. compound engines, each coupled to a two-pole dynamo, for the sum of £1,377 each. Mr. Rutherford wished to know what sort of engines they were to be, and what their horse-power was to be. Mr. Petrie, as ex-chairman of the committee, said that some two years ago the subject of these engines was fully discussed in the Council, and a certain type of engine was adopted for certain valid reasons. These were the engines which it was now proposed to buy, as being those which, in the opinion of experts, were the best suited to these stations. [It was here discovered that a quorum was not present, and therefore the matter could not be decided.] Mr. Petrie said that unless this contract were soon entered into, the whole of the electric tramway system would be delayed unduly, and he hoped that a Council meeting would be held as soon as possible to deal with the subject.

Some opposition has been raised by commercial interests to the introduction of electric traction into certain streets, where it is feared the heavy traffic of the port would be hampered by the tramcars. The matter will be considered at a special meeting to be held on October 11th.

Newcastle-on-Tyne.—At last week's City Council meeting Mr. Cail presented the report of the New Tramways Committee. The report stated that on February 21st the Council adopted the overhead trolley system of electric traction on the tramways with the proviso that the system be not constructed in the streets in the centre of the city until the Council had considered and decided whether in those streets some system of electric traction other than overhead traction was practicable, and could be worked in conjunction with the overhead system in the other streets upon the tramway routes. The New Tramways Committee was requested to get the opinion of experts on the point. Prof. Kennedy had given his opinion that as a matter of mere practicability, the Committee's question must be answered in the affirmative. There were systems, he said, not requiring overhead wires, which could be worked in conjunction with an overhead system, but whether it was desirable for the Committee to adopt a combined system of this kind was a matter which the Committee must decide for themselves. There were several cities in which an overhead system and a conduit system were running together and in connection. In cost of construction they certainly would be more than an ordinary overhead line, but he was sure there would be no special difficulty in working from one system to the other. Mr. Chas. Hopkinson, in his report to the Committee, advised the Committee not to combine the overhead trolley and conduit systems. He advised that the trolley system be installed throughout, but that in the central part of the town, where overhead wires were objected to, it be regarded as temporarily installed, pending proof from prolonged use elsewhere of one or other of the surface contact systems. The Committee, after having given careful consideration to the subject, recommended the Council to adopt the trolley system for the entire tramways in the city, as recommended by Mr. Charles Hopkinson, on the distinct understanding that the trolley system in the central part of the city is to be recognised as only a temporary arrangement in order that the views of those who object to the overhead system may be met when this can be satisfactorily accomplished. It was decided to have a special Council meeting on 13th inst., when the report will be considered.

Oldham.—The Town Council last week discussed the minutes of the Surveyors' and Tramways Committee, which contained the following:—"Resolved, that the motive power to be employed in Oldham be electricity, and that the system be the overhead trolley system."—Alderman Eckersley, in his capacity as chairman of the committee, gave a lucid and exhaustive explanation of the proposed scheme, and made it clear that, as against the alternative plan of the conduit system, the overhead or trolley system of traction was the best for a borough like Oldham. It commended itself on account of its cheapness in construction and maintenance, its simplicity and ease in effecting repairs, and the rapidity with which the lines could be constructed, and the comparatively small interference with the surface of the streets and the traffic. The opposite conditions would, he said, attend the conduit system, in addition to the enormous expenses of construction which it would entail. The borough would scarcely be justified in spending a million of money when a quarter of the sum would suffice to provide a system of traction which, in the future, would not require as much in maintenance as its rival. The minutes were ultimately adopted unanimously.

St. Helens.—The Council is applying for a provisional order authorising extensions of the tramways along certain thoroughfares.

Sheffield.—The Tramways Committee intend to obtain powers for doubling all single lines at any suitable time, to carry goods and merchandise on the tramways, and to construct 11 new sections of tramway.

South Australia.—The Adelaide correspondent of the *British Australasian* says that it is reported that an English syndicate is willing to find the necessary capital to convert the principal tramlines into an electrical system. The proposal is to amalgamate the companies and form one large company, and to subscribe the additional capital required.

Stirling.—The British Electric Traction Company applied to the Central District Committee last week for approval of a scheme for a tramway or light railway from Stirling along the Hillfoot district, on the overhead trolley system. The Committee unanimously agreed to give a general approval to the scheme.

Stockport.—The Council has given notice to the Manchester Tramways and Carriage Company requiring them to sell to the Council so much of their undertaking as is within the borough of Stockport. The Council has adopted a report of the Tramways Committee ordering a survey of certain routes with a view to the introduction into the borough of an electric tramways service, and appointing sub-committees to confer with the local authorities of Reddish, Cheadle, Bredbury, and Bramhall, whose districts adjoin the borough. There was a general expression of opinion that this Committee should prosecute its special work with all vigour.

Swansea.—The relaying of the tramlines is now completed, the poles are in position, and the power station is said to be nearly ready. The cars will complete the system.

Wakefield.—The Corporation is being besieged by applicants for permission to promote a light railway or tramway in and about the town, three communications having been received recently.

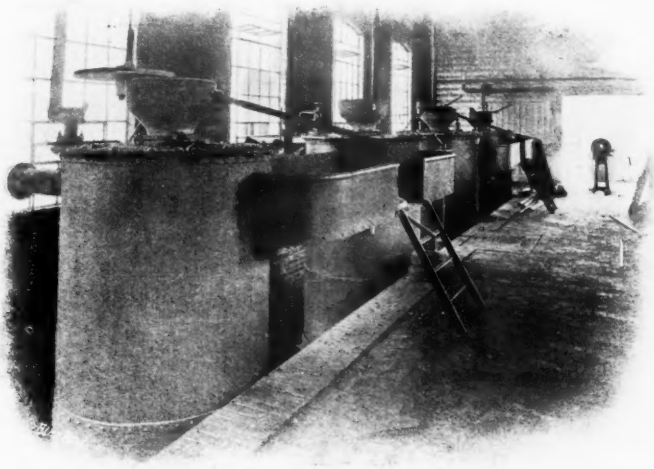
West Riding.—The District Councils of Queensbury, Sowerby Bridge and Elland, have been in negotiation with the Halifax Tramways Committee with regard to proposed extensions of the Halifax tramways to their respective areas. Queensbury has also conferred with Bradford as to the junction of the Halifax and Bradford tramways, and Elland is inquiring of the Huddersfield Corporation as to an extension to Elland. Yeadon has invited Rawdon and Horsforth to consider proposals made by the Leeds Parliamentary Committee with regard to the proposed extension from Kirkstall to Yeadon.

Worcester.—Messrs. Kincaid, Waller & Manville have advised the Council to take over the tramways and work them municipally as electrical lines. Their report also referred to the scheme of the Tramways Company, and the light railway extensions, which the company proposes, are said to be really extensions to the existing tramways. The negotiations between the company and the committees were referred to last week. The Council has referred that matter and the report of Messrs. Kincaid to the Joint Street and Electricity Committees for reconsideration. The report says that if the Corporation gave their assent to the light railways scheme, they should be prepared to assent to the Tramways Company having a new tenure in some form of the existing lines. If, on the other hand, the Corporation desired to avail themselves of the powers of purchase in respect of the tramways, there was no question but that the application of the Tramways Company for extensions should be vigorously opposed. They estimated the cost of acquiring and reconstructing the existing tramways, and of making the extensions, equipping the lines with rolling stock, and incidental expenses, at £72,180, without providing for generating plant, or feeders, leaving that important point to be considered in conjunction with the electric light undertaking. They estimated the receipts per car mile at 9d., as compared with 9¼d. given in the company's balance-sheet for 1898. Thus the total receipts on an estimate of 500,000 car miles would be £18,750, to which must be added £500 per annum for advertisements. They put the working expenses at 6d. per car mile, £12,500; interest on £73,000 at 3 per cent., £2,190; redemption of loan, £1,776; total, £16,336. The estimated net profits would, therefore, amount to £2,884 per annum.

Rennes Telegrams.—Reuter's agent says that as many as eight or nine million words were despatched over the telegraph wires from Rennes in the course of the Dreyfus trial, and on Saturday last the telegraph receipts amounted to 450,000f. (£18,000). The number of direct telegrams sent announcing the sentence and verdict was about 3,000.

THE LIGHTING OF LYNN.

A mere glance at an ordinary railway map of Norfolk brings home to the mind of the electrical engineer who is acquainted with the course of electric lighting progress in this country what a small amount of such work has, so far, been accomplished within the county. We think of the attempts made by a company to light Thetford, attempts which were not rewarded with sufficient business to allow the continuance of the works, which consequently came under the hammer a few years ago. We think of Cromer, the fashionable and quiet watering place on the north-east, where, although the electrical engineer has done his best during recent years to bring a scheme to a head, nothing has been actually done. There are Hunstanton, Dereham, and a host of other towns, where the electrical engineer has yet to find his way, and this he will probably do within the next few years.



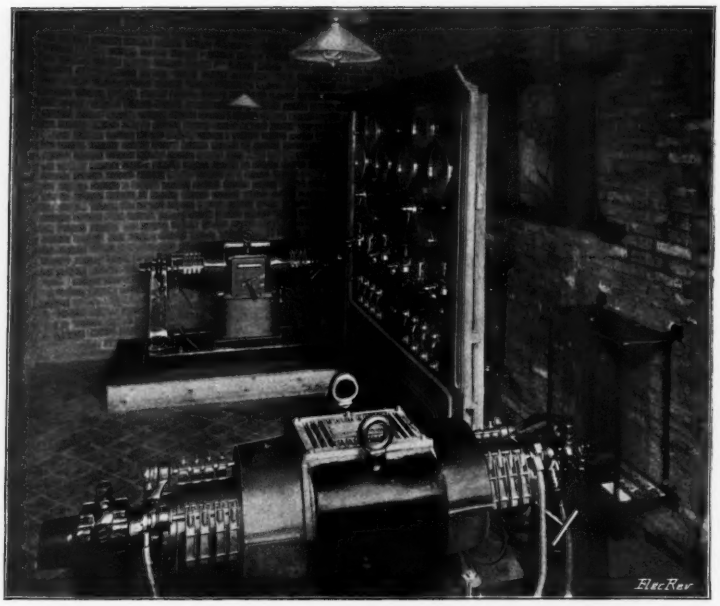
Gas Producers.

The municipal plant at Great Yarmouth, with its electric tram scheme now working out, and the electricity supply system of the Norwich Company, are satisfactory undertakings. But beyond these, there is practically nothing to speak of, for the county consists of some scores of small villages or towns, the largest of which can boast of only 3,000 to 5,000 population—a population which varies, we should think, very little indeed in the course of the year, save in the case of the more prominent holiday resorts on the coast.

Electrical engineers are so fully occupied with large lighting, traction, and power schemes just now, that it may be

Gas Producer House, Holder, Etc.

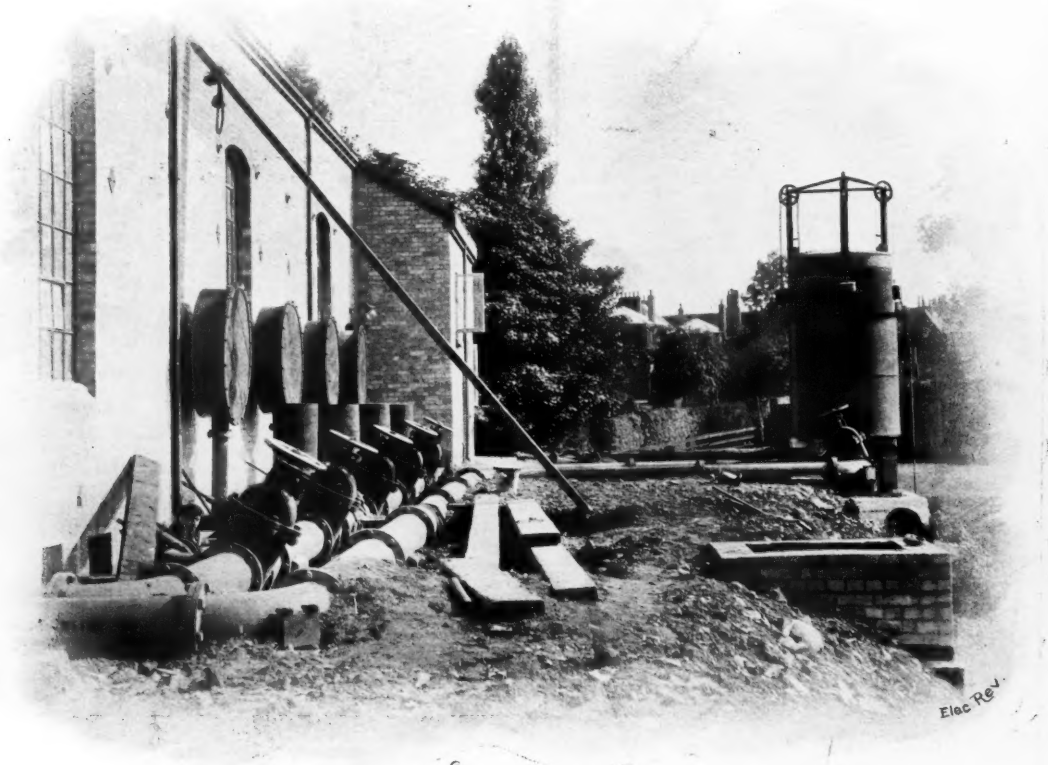
thought to be hardly worth the candle at the present moment to consider the numerous small districts throughout the country. When the needs of larger towns have been attended to, however, the question of electric lighting must be eventually raised, unless gas or oil is for ever to hold sway. There is, of course, the very important question arising as to whether it would pay at all to introduce electric lighting by a public installation into these small scattered, and by no means wealthy, districts until the costs can be reduced to a lower figure than at present. We imagine that the most likely way in which it may be arranged will be for the Yarmouth, Norwich and Lynn, and any other of the larger works to distribute current for meeting the needs of the adjacent smaller places, unless small isolated gas-driven plants can be put down.



Town Hall Substation.

In the preceding remarks we have not made particular reference to the town of Lynn, or King's Lynn, the population of which is somewhere between 18,000 and 20,000; this fact bringing it outside the category mentioned. There seems to be a good future in store for electric lighting here.

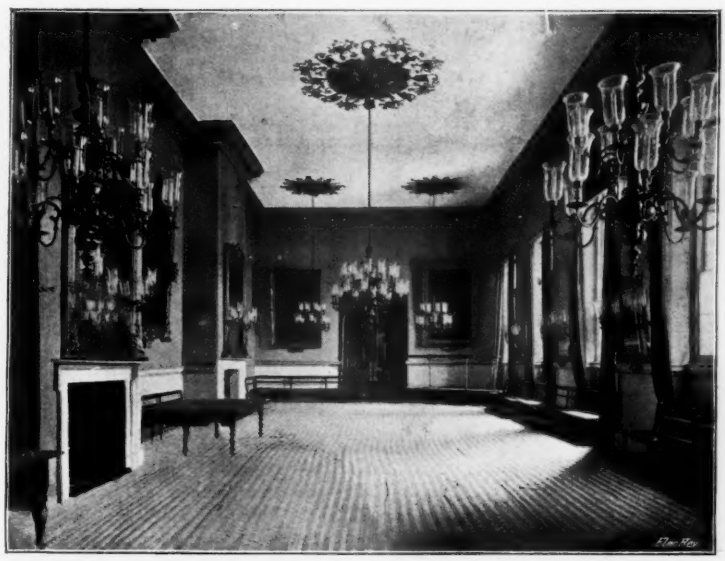
We need hardly refer to the history of the negotiations leading up to the adoption of a municipal electrical scheme. The opposition of gas interests is a foregone conclusion nowadays, inevitable as electric lighting is, but at Lynn in the matter of street lighting there is to be a clean sweep made, electricity being adopted throughout, although incandescent gas, which is proving so powerful an opponent—perhaps only temporarily—for street lighting in Bolton, Liverpool, and other towns on account of cost, has been on its trial here for some time. In some streets the mantles are still employed pending the completion of the erection of the electric light standards. It is little consolation to gas interests at Lynn to know that the plant is gas-driven, for while the town supply of gas is drawn upon, this is done only to a very limited extent, as the gas-producing plant installed in accordance with a scheme of Prof.



Auxiliary Gas Holder.

H. Robinson is primarily responsible for the supply. The gas street lamps are being shut off in batches at certain prearranged periods, and when the electric lighting scheme is completed, there will be electric arc and incandescents for public lighting to the number of about 400.

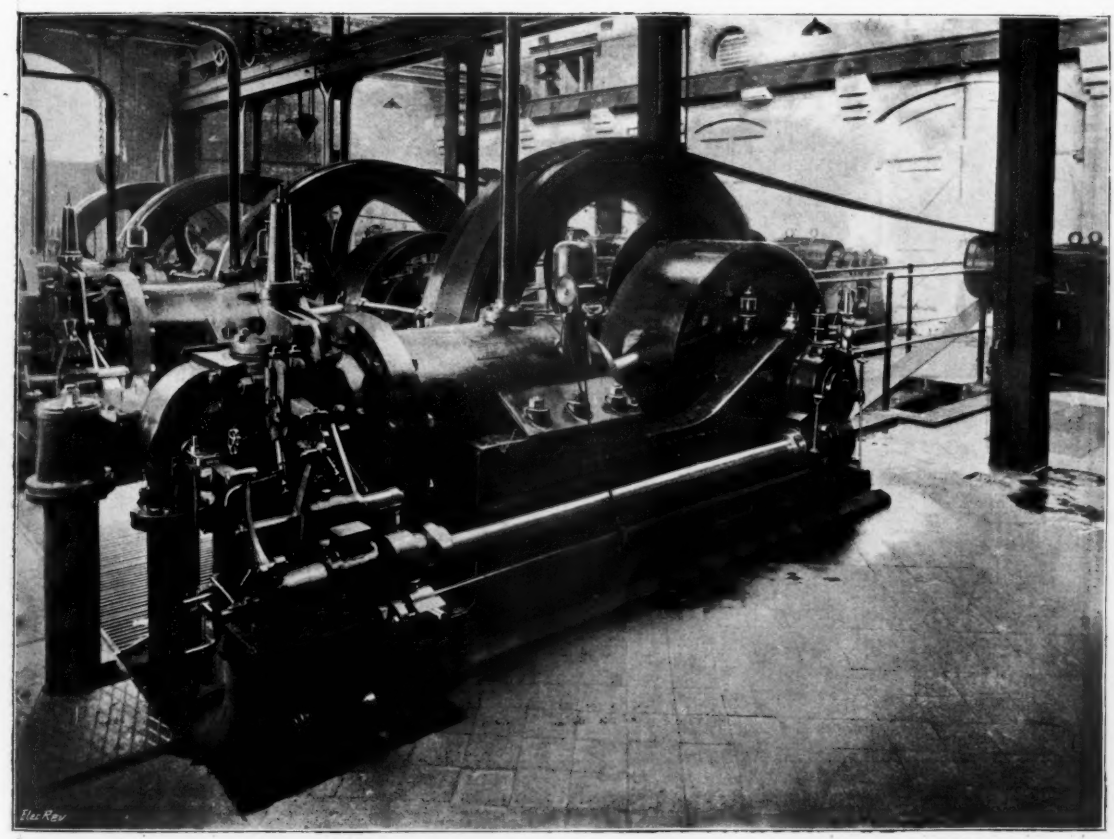
The subject of gas-driven installations is an interesting one. The vicissitudes through which some public works have passed, leading to the abandonment of the Coatbridge and Morecambe plants, and the adoption of steam driving for extensions at Belfast, formed important chapters in the history of this particular class of installation, chapters in which so much has been already written, that we need not enlarge further. The successes of the Midland Railway plant at Leicester must not be forgotten, and more particularly we must not overlook the works of the Leyton Town Council, where Dowson gas plant has been used for the past two or three years in accordance with the scheme drawn up by Prof. Henry Robinson. The generating costs at Leyton have, we understand, worked out at a very low figure.



The Ball Room.

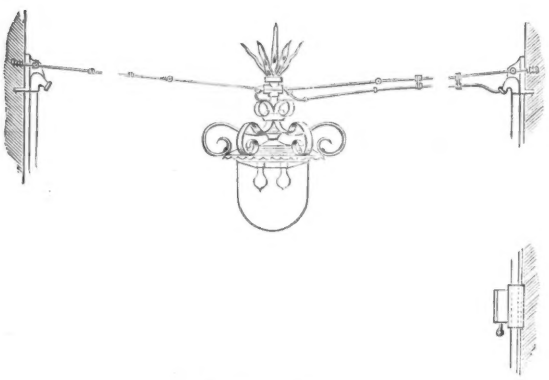
The King's Lynn electricity scheme also has been designed by Prof. H. Robinson, although the equipment differs somewhat, the experience of Leyton working having been taken advantage of. We may therefore hope that the results of the Lynn supply may be equally, if not more, successful.

The Lynn contracts were placed just about twelve months ago, and things would have been ready earlier but for the effects of the engineering strike. The total amount of loan raised for the works is about £30,000. The area supplied is a compact one, and the small consumer predominates. Consumers are charged 5½d. per unit, with a discount beyond certain consumptions. The Corporation has its own house wiring department, and it is, perhaps, needless to remark that this arrangement is not



Interior of Station, showing Gas Engine.

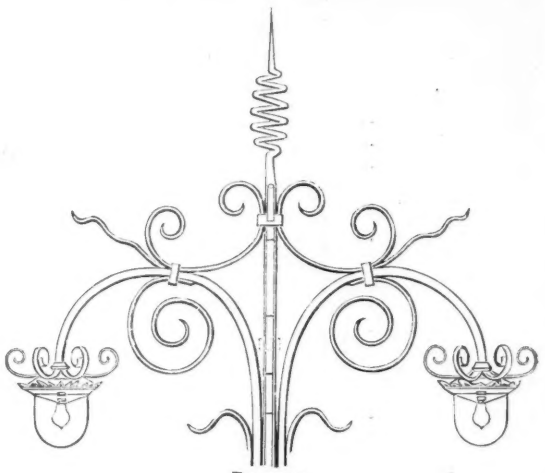
altogether palatable to the many ironmongers who have suddenly been metamorphosed into "electrical engineers." At present there are 150 consumers connected, with 4,000 8-c.p. lamps. Gas engines are very largely used for mill work, so that there is room for a good business in the supply of current for motor driving if that branch is energetically pushed. The Council is its own best customer, for the



Suspended Lamp.

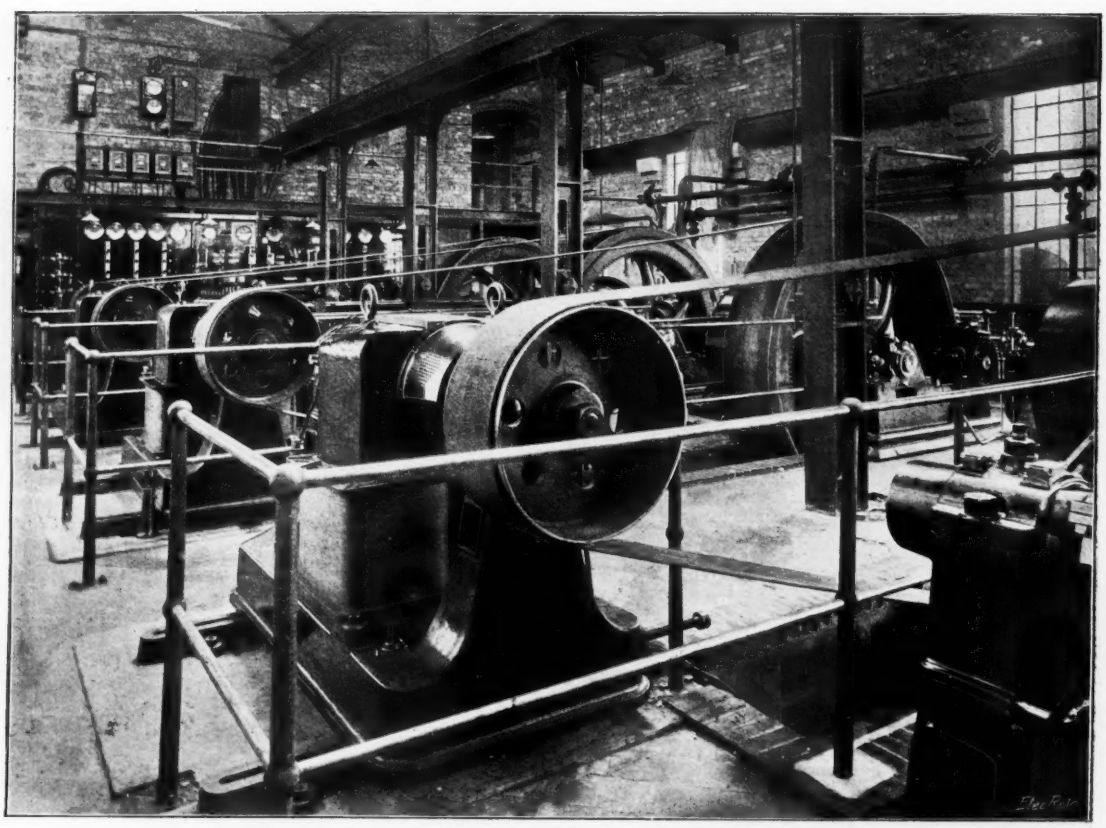
Town Hall departments have 350 lights and the theatre another 350, all of 8 c.p.

On the occasion of our visit to Lynn, we inspected the wiring and fitting work which had been carried out by Messrs. Spagnoletti & Crookes at the Town Hall buildings. The various departments are now furnished with very artistic fittings for electric lighting. The Court of Sessions has several wrought-iron electroliers of an exceedingly pleasing design, with nine 16's. In the ballroom a number of very valuable old spider fittings have been converted into electroliers. We give an illustration showing this piece of special work. The centre fitting has 24 candles with 5 c.p. incandescents, and the four others have sixteen 5's. The wall fittings bring up the number of electric candles in this room to 140. Messrs. Spagnoletti & Crookes were also the contractors for the wiring of the various other departments here, as well as the theatre already mentioned.



Bracket.

The site of the electricity works is on the ground of the Old Water Works, where there is a convenient siding to the G.E.R. The buildings are engine and dynamo house, with battery room and offices, and the producer house which is situated a few yards away. An idea of the general arrangement of the gas-producer house, gas-holder, scrubbers, &c., can be obtained from one of the exterior photographs accompanying this article.



Interior of Station showing Dynamos and Switchboard.

The system of supply is three-wire continuous current distribution at 400 volts pressure, 200 volts on each side of the middle wire. Consumers are supplied at 200 volts.

The gas-producer house contains, as will be seen from the picture, plant of the usual type for working with anthracite coal, or coke when necessary. All the gas-producing plant was supplied and installed by Messrs. Fielding & Platt, Limited. There are four sets of gas generators lined with firebrick, set in fireclay and ground cinders. They are fitted with steam jet air injectors, fire bars, cleaning out doors, and feeding hoppers with cover lids. All of the generators are of the same external size, but one has a thicker firebrick lining to reduce the area of the furnace to three-fourths of that of the other three generators. It is, however, so constructed that it can be easily re-lined at a future time to form a full-sized furnace. Each generator (with full-sized furnace) is capable of producing 13,000 cubic

Lamp-post.

feet of gas per hour, of a calorific value of not less than 145 B.Th.U. per cubic foot. Each of these producers is for driving two of the engines in the station. They all feed, as shown, into one common gas-holder, so that the production of gas can be regulated in proportion to the requirements of the station. This ensures fuel economy. The fuel used is anthracite peas, the consumption upon preliminary tests being found to work out at under 1 lb. per I.H.P. per hour. The generators are placed 10 feet apart from centre to centre, and close to the edge of the feeding platform. An iron hood is erected over each producer, with an outlet chimney, and the waste gas pipe discharges under the hood. The gas passes through a series of vertical cast-iron pipes erected outside the producer house, and is cooled by water trickling down the outside of the pipes, with even distribution over the surface. After leaving the cooler the gas passes through a cast-iron hydraulic box fitted with water supply and overflow pipes; it then passes through two scrubbers, one of which is filled with coke and supplied with a water spray and trapped outlet drain, and the other is filled with sawdust. The gas outlet from the sawdust scrubber is provided with a breeches piece and two 6-inch stop valves. In one corner of the producer house there is a small vertical boiler for supplying steam to three generators when working together. It is for delivering 39,000 cubic feet of gas per hour into the gas-holders at a pressure of 1½ inches of water. When required, however, a steam supply will be available from the existing waterworks boilers. The main gas-holder, which was let down before our photo was taken, and therefore does not appear to advantage, is of wrought-iron, 20 feet diameter, with a 10-foot lift. The inlet and main outlet pipes are 12 inches internal diameter, and a 2-inch diameter outlet supplies the ignition burners of the engines. In another view we show an auxiliary gas-holder, 5 feet diameter (with 5 feet lift), which is erected at the extreme end of the gas main, and close to the engine side of the electricity works. The mains from the scrubbers to the main gas-holder are 12 inches diameter, and from there to the auxiliary holder 10 inches diameter. The branches to the engines are 5 inches diameter, and to the generators 6 inches diameter.

Coming now to the interior of the electric generating station, of which we give views taken from either end, there are in position four sets of Fielding & Platt gas engines and General Electric Company's dynamos. The fifth dynamo is on the ground, waiting for its engine. The present night demand requires two of the sets to be running, and a third turning round. The engines consist of the latest designed Fielding patent gas engines, driven by belt direct from the fly-wheel on to the dynamo. Each engine is capable of giving off 100 B.H.P. as a maximum, the ordinary constant working load being 76 B.H.P.

The engines are of exceedingly massive design, specially designed for electric driving. They are fitted with single heavy fly-wheel and outer bearing, the fly-wheel weighing 8 tons, to ensure absolutely steady running. Each engine is fitted with Fielding's patent self-starter and hand turning gear for positioning the engine, enabling one man to start either engine with ease. An improved arrangement of timing cam has been adopted, enabling the point of ignition to be adjusted whilst the engine is running. This is of great importance where varying loads occur.

The dynamos supplied by the General Electric Company, Limited, of London, are of the continuous current shunt-wound type, which can be separately excited off 400-volt mains. They have self-oiling ring bearings. The driving pulley has been proportioned to suit the speed of the engines (150 revolutions per minute). Each dynamo has a normal speed full load output of 40 KW., ranging from 88 amperes at 450 volts to 80 amperes at 500 volts. For battery charging the speed may be exceeded by 10 per cent., and the output may then increase to 80 amperes at 540 volts. The dynamos will be run with separate excitation ordinarily, but upon emergencies they will be run self-exciting, a resistance being provided in the negative lead to the change-over switch to reduce the field circuit pressure by 110 volts.

The accumulator room is arranged in an exceedingly convenient manner. Instead of being arranged in the usual way on tiers, the cells are on two floors, the top one being open through. There are four rows of cells on each floor. There are 225 cells of the well-known Chloride "R" type. The boxes are of glass, and each contains eight positive plates and nine negative plates of the makers' standard size. The specification required that the battery should be capable of discharging at the rate of 40 amperes for 10 hours or 80 amperes for 4 hours without the E.M.F. of any cell falling below 1·85 volts. The cells are mounted upon pitch pine bearers, being insulated from same with the usual glass insulators. The bearers rest upon cross bearers, the latter being insulated from earth by large porcelain insulators. The connections between the regulating cells (which are 38 in number) and the switchboard consist of copper rod so far as the engine room wall, when they are changed to cable by means of a terminal board. This battery is intended for balancing on the three-wire system, and also as a stand-by.

At the Town Hall there is a transformer sub-station, which we illustrate. Here it will be seen that there are two motor transformers (of the Byng-Hawkins type) for balancing the load. The armatures are wound on the same drum with an 80 segment commutator at each end. They are wound for 50 amperes at 200 volts, or 400 volts across the two windings. The normal speed is not less than 1,200 revolutions per minute. The magnets are excited at 400 volts from the outers. The exciting circuit is provided with a fuse and switch arranged to discharge the field through a non-inductive resistance. The leads connecting to the mains have positive main, middle conductor, and negative main switches. The sub-station switchboard, which is seen on the right in our photograph, has two voltmeters, reading up to 250 volts, with fuses in porcelain boxes on the leads connecting to the mains.

The main switchboard in the generating station is made up of slate slabs mounted on vertical iron supports fixed by the builder. The rheostat switches are placed on a slate table supported on iron brackets in front of the centre of the board. The switchboard contract as well as the sub-station equipment, the main dynamos, the station lighting, &c., was carried out by the General Electric Company, Limited, who were represented during construction by Mr. W. A. Dyer, A.M.I.E.E.

In the power station there is a 10-ton traveller for the gas engine side, and a 3-ton for the dynamo side, as shown in our interior view.

The system of distribution, as already mentioned, is a three-wire one, with 200 volts on each side, and the mains are fed by two-wire feeders at six different points. The balance is obtained by a third or neutral wire feeder from the sub-station balancing machine at the Town Hall, and two distributing mains, which are run directly into the generating station.

The cables supplied up to the present are as follows:—

·15 sq. in.	Concentric unarmoured feeder ...	1,863 yards.
·1 sq. in.	Concentric unarmoured feeder ...	622 „
·1 sq. in. ·033 sq. in. ·1 sq. in.	Triple concentric unarmoured main...	1,506 „
·15 sq. in.	Concentric armoured feeder	1,281 „
·1 sq. in.	Concentric armoured feeder	472 „
·15 sq. in.	Single (neutral wire) armoured feeder	140 „
·1 sq. in. ·033 sq. in. ·1 sq. in.	Triple concentric armoured main, A size	8,628 „
·05 sq. in. ·025 sq. in. ·05 sq. in.	Triple concentric armoured main, B size	4,242 „

The cables leaving the generating station are two ·15 square inch, and one ·1 square inch unarmoured feeders, and one unarmoured main in a line of six-way Doulton casing, and also a triple concentric main A size, which serves a new district near the dock, and enters the station in the opposite direction from the other cables. The conduit line runs out into the main road where the ·1 square inch feeder divides into two cables, one running as an armoured cable to a point in the Gaywood Road, and the other continuing in the conduit line to a feeding box opposite the railway station. The cables are in all cases carried across the roads in cast-iron pipes, two 4-inch pipes being provided on all conduit lines to allow of extension, and each armoured cable being drawn into a 3-inch cast-iron pipe. The six-way conduits are laid from the generating station to the junction of Blackfriars Road and Norfolk Street, where they are continued in a four-way conduit, one line carrying a ·15 square inch feeder and main being laid down Norfolk Street to the junction of Broad Street and Chapel Street, where the conduits stop, and the feeder divides into two armoured feeders, one branch running to the post office and the other to St. Nicholas Church at corner of Chapel Street. The other four-way conduits are laid down Blackfriars Street past the railway station, where the ·1 square inch feeder is connected into the network, and the conduits are then continued with three-ways, carrying the other ·15 square inch feeder and a distributing main. These run to the junction of London Road, where the conduits stop, and this feeder divides into two armoured cables, one serving the London Road, the other running to the end of High Street in the St. James's Road. The armoured cables are everywhere covered by a creosoted board laid over them to serve as a protection, and as an indication of their existence in the case of further excavation in the streets.

The cables themselves are composed of plain copper conductors, insulated with impregnated fibrous material and lead cased. The unarmoured cables are further protected by a short layer of tarred yarn and thoroughly compounded, and the armoured ones by two layers of steel hooping and tarred yarn as usual.

The insulation resistance measured when laid before service connections were made was 2,000 megs. per mile between either conductor and the other two connected to earth.

The method of making services and the various joint and fuse boxes are all of Prof. Robinson's design, and we hope to give drawings of some of these in our next issue. In order to simplify the making of services on both sides of the system, the polarity of the outermost conductor of the mains is reversed at intervals by means of special boxes, and as the neutral wire is the middle wire the cable connections need only be made on to the outer and neutral, thus obviating the necessity of cutting down to the innermost conductor, and enabling connections to be put on with only one side of the system cut off at the street disconnecting boxes. The middle or neutral is earthed at the generating station.

The public lamps and private services are connected to the mains by means of I.R. braided wire run in wrought-iron tubes, and connected by fuses to the terminals in the service boxes.

The incandescent lamps for street lighting are placed in specially-designed ornamental lanterns on posts in streets where the paving or roads are sufficiently wide, and supported on wall brackets or on suspension wires where the streets or footways are too narrow to allow of posts being used. For the lighting of "The Walks" a special double arm standard is used, as will be seen from one of our sketches; while for cross corners here some of the standards have four arms. The lamps are run off the distributing mains in parallel, and 200-volt lamps are used throughout. In the more important thoroughfares and corners arc lamps are to be placed, and these are either open arcs run four in series on the 200-volt mains, or enclosed arcs run two in series on the same voltage. Eight of the lamps are of Siemens's "Band" (5-ampere) type, and eight (7-ampere enclosed) are by the Davy Company. The arc lamp standards also carry two 16-C.P. incandescents. The lamps are controlled from the base of the lamp-posts. The arrangement is such that the lamp-lighter's occupation is not gone.

In High Street, which is a narrow and busy street, the lighting is to be effected by means of lamps suspended on ornamental wrought-iron arches carried on the walls of the buildings on opposite sides of the street.

The whole of the work connected with the mains and conduits and street lighting is being carried out by Messrs. Siemens Brothers & Co., with the exception of the lamp-posts, brackets and arches, which have been purchased direct from the founders (Messrs. Law, of Glasgow). The street lighting extensions which have been arranged for since the original contracts were placed, are also being carried out by Messrs. Siemens.

The following is a list of the contractors:—

Buildings	Messrs. Merredew & Wort, Stevenage.
Gas producing plant and gas engines.	Messrs. Fielding & Platt, Limited, Gloucester.
Dynamos, switchboards (main and sub-station), &c.	General Electric Company, Limited.
Accumulators	Chloride Electrical Storage Syndicate.
Public lamps, lanterns and main work.	Messrs. Siemens Bros. & Co.
Lamp-posts, brackets and arches for public lighting.	Messrs. J. & A. Law, Glasgow.
Meters...	Long-Schattner.
Arc Lamps	Messrs. Siemens and the Davy Company.
Stoneware conduits	Messrs. Doulton & Co.

It would not be fitting for us to bring this article to a close without acknowledging our indebtedness to the consulting engineer, Prof. Henry Robinson, and to some of the contractors who have taken part in the Lynn installation. To Mr. Leigh Robinson, son of the consultant, who has been on the spot for the past 11 or 12 months controlling the carrying out of the work, we especially owe a debt of gratitude for placing at our disposal certain material for the compilation of our description, and also for the kindly and courteous way in which he placed himself at the service of our representative on the occasion of a recent visit.

The resident electrical engineer, appointed about five months ago, is Mr. J. Pilling, and Mr. Williams has been appointed assistant.

Change of Name.—We note that our esteemed contemporary, the *Railway World*, has changed its name to the *Tramway and Railway World*. This is not to denote any alteration in the policy of conducting the paper, as our contemporary has always been, what we regard over here, more of a tramway journal than anything else.

TELEGRAPH AND TELEPHONE NOTES.

Bedford.—The Town Council has unanimously empowered its Telephone Committee to apply to the Postmaster-General for a municipal telephone license under the powers conferred by the new Act.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa...	April 4th, 1898 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Accra-Grand Bassam... ...	August 1st, 1899 ...	Sept. 8th, 1899
Corea-Japan	August 7th, 1899 ...	...
Cheik Saiid-Perim	Sept. 3rd, 1899 ...	...
Jamaica-Colon	June 30th, 1899 ...	...
Jamaica-Porto Rico (Ponce)	August 14th, 1899...	Sept. 13th, 1899
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899...	...
Communication between Bolama-Bissao	July 28th, 1899 ...	...
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, and Cape Haitien, Port au Prince to Miribalais and Jacmel	August 18th, 1899 ...	...
Moulmein-Bangkok	Sept. 8th, 1899 ...	Sept. 8th, 1899
Saigon-Bangkok	Sept. 12th, 1899 ...	

The Telegraphic Wire Export Trade.—The past month proved to be a relatively quiet one as regards the export trade of this country in telegraphic wire and apparatus connected therewith. The returns just issued for August show that the value of the shipments only amounted to £87,517 as compared with £97,635 in the preceding month, and no less than £265,501 in August, 1898. Earlier in the year, 1899 gave promise of seeing record figures set down, but the quietness of the past few months has put the total behind that of last year, the value of the exports during the eight months ending with August last having reached a total of only £686,825, which compares with £811,997 in the corresponding period of last year, and with £700,748 in the first eight months of 1897.

Wireless Telegraphy.—According to the *Review of the River Plate* a representative of the Wireless Telegraph and Signal Company, of London, has been establishing the Marconi patent in River Plate and other South American countries. A set of apparatus has been at work in Buenos Ayres recently.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Barnsley.—September 16th. Tenders are wanted for electric light wiring and fittings at the Harvey Institute, Eldon Street, for about 700 lights. See "Official Notices" August 18th.

Belfast.—September 31st. The Electric Committee wants tenders for c.i. floor plates and w.i. rails for the electric light department. Specifications from the city electrical engineer on payment of one guinea, returnable as usual.

Birkenhead.—September 29th. The Corporation wants tenders for boosters, switchboard, accumulators, cables, and laying same. See "Official Notices" this week.

Blackburn.—September 20th. The Corporation wants tenders for 40 electric cars and two 256-kw. steam dynamos. See "Official Notices" September 8th.

Cardiff.—September 27th. The Corporation wants tenders for cast-iron arc lamp-posts. See "Official Notices" this week.

Carlisle.—September 18th. The Corporation wants tenders for extension of switchboard for dynamos 5 and 6, and for traction work. See "Official Notices" September 1st.

Darwen.—September 25th. The Corporation wants tenders for a high speed vertical engine and dynamo (300 to 350 kw.); also switch work. See "Official Notices" September 8th.

Germany.—September 20th. Tenders are being invited until September 20th by the Cotton Wool Exchange authorities in Bremen for a complete installation of electric lighting in the new Exchange. Tenders are to be sent to Das Banbureau für die Bremer Baumvoll börse la Dechanatstrasse, Bremen, whence particulars may be obtained.

Germany.—October 16th. Tenders are being invited by the municipal lighting and tramway authorities of Königsberg, Prussia, until October 16th, for the supply of six boilers required in connection with the extension of the electric power station, to supply steam to new engines aggregating 1,800 h.h.p. Tenders to be sent to Die Direction der Städt, Belenchtungswerke und der Electr. Strassenbahnen Kaiserstrasse 41, Königsberg, Prussia, whence particulars may be obtained for 1s.

Glasgow.—October 10th. In connection with the tramway scheme the Corporation wants tenders for switchboards, fuel economisers, two 50 and one 30-ton electric travellers, power station steel work, and cables. See "Official Notices" September 8th.

Heckmondwike.—September 20th. The District Council wants tenders for the supply of water-tube boilers, economiser, pipe work, steam dynamos and motor boosters, accumulators, switchboard work, travelling crane, mains, arc lamps and posts, and station lighting. See "Official Notices" August 25th.

Huddersfield.—October 2nd. The Corporation wants tenders for five Lancashire boilers. See "Official Notices."

Ilfracombe.—September 25th. The District Council wants tenders for boiler plant, engine plant, dynamos, condensers, switchboard, mains, lamp-posts, accumulators, meters, crane, buildings, &c. See "Official Notices", August 18th.

Luton.—September 22nd. The Council wants tenders for boilers, superheaters, engines, dynamos, switchboard, steam and other piping, batteries, street conduits, boxes, feeders, arc lamps and posts, and various other plant and machinery for the electric lighting installation. See "Official Notices" August 25th.

Middleton.—September 20th. The Corporation wants tenders for Lancashire boilers, superheaters, economisers, steam pumps, condensers, steam dynamos, balancer and boosters, switchboard, accumulators, cables, crane, &c., for electricity works. See "Official Notices" September 1st.

Oldham.—The Electric Light Committee invites tenders for rolled steel girders, concreting, and other works required in the foundations for "Klein's Tower Water Cooler" at the electric light station, Gas Street, Oldham.

Rotherham.—October 9th. The Corporation wants tenders for Lancashire boilers, engines, dynamos, piping, condenser, economiser, battery, switchboard and boosters, feeders, mains, road work, &c., for electric lighting. For particulars see "Official Notices" September 8th.

Runcorn.—September 27th. The Urban Council is inviting offers for the electric lighting of the district, to be sent to the chairman of the Highways Committee.

Russia.—The municipal authorities of Perm are at present inviting tenders for the concession for the establishment and exploitation of a central electric lighting station in the town.

Salford.—September 28th. The Corporation wants tenders for 16 Lancashire boilers and superheaters. See "Official Notices."

Sculcoates Union.—September 21st. The Guardians want tenders for the installation of electric lighting and telephones at the Workhouse. See "Official Notices."

South Wales.—September 28th. The proprietors of Margam Copper Works, Port Talbot, wants tenders for the electric lighting (arc and incandescent) of their works. See "Official Notices" September 8th.

Sunderland.—The Corporation wants tenders for four 270-kw. three-crank direct current steam dynamos, and two surface condensers and cooling tower. See "Official Notices" August 18th.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warrington.—September 30th. The Committee of Visitors of the Winwick Asylum, near Warrington, invite tenders for Contract No. 1.—Generating plant, including three sets of condensing engines or turbines, with directly coupled dynamos, each of 100 kw. output at 220 volts, booster set, motors, surface condensers, cooling tower, steam and exhaust pipes, &c. Contract No. 2.—Switchboard. The drawings can be inspected and specifications obtained of J. P. Muspratt, Clerk to the Committee of Visitors, County Offices, Preston, on payment of £2 2s for each specification, returnable. A separate tender must be sent in for the work included in each specification. See "Official Notices" September 8th.

CLOSED.

Bexhill.—The Council has approved the acceptance of the tender of £3,600 by Mr. Minter, for the erection of electricity works buildings.

Colwyn Bay.—At a special meeting of the Council held last week the tenders of Mr. Bertram Thomas, of Manchester, for carrying out the electric lighting of the town to the specification of Messrs. Lacey, Clirehugh & Sillar were accepted.

Glasgow.—An exchange says that the following tenders have been accepted in connection with the equipment of the electric tramway power station for the Corporation: Mirrlees, Watson, and Yaryan Company, Glasgow, surface condensers and air pumps, £15,000; Mavor & Coulson, Glasgow, centrifugal circulating pumps; G. and J. Weir, Glasgow, boiler feed pumps.

Grimsby.—The Town Council has confirmed the acceptance of the following tenders for electric lighting plant and machinery:—

Boilers.—Messrs. A. Anderton & Sons, Accrington	£1,875
Engines, Dynamos, &c.—Messrs. Mather & Platt, Limited, Salford Iron Works, Manchester (this to include series windings)	12,510
Battery.—The Tudor Accumulator Company, Limited, London	850
For maintenance	54
Switchboard.—Messrs. James White, Limited, Glasgow	1,350
Mains.—The British Insulated Wire Company, Prescot	14,967
Total	£31,606

There was some discussion as to the reason of the original estimate being exceeded, but after explanations as to additional machinery and buildings the minutes were adopted.

Halifax.—The Council has confirmed the acceptance of the following tender:—Messrs. Belliss and the Electric Construction Company, Limited, for the supply of three 1,200-H.P. engines and 750-KW. generators for £7,419 each.

Leeds.—The City Council has accepted the tender of Mr. E. C. Wallis for an electric light installation (£462) for the wholesale meat market.

Leeds.—The Tramways Committee has accepted the tender of Mr. T. Harding Churton for the electric lighting of the car sheds, for the sum of £1,170.

Wigan.—The Council has accepted the tender of Mr. W. Winnard, of Wigan, for the erection of electricity works buildings at £15,789. The highest tender was £16,289.

THE LONDON COUNTY COUNCIL AND ELECTRICITY.

The Highways Committee of the London County Council has just issued a very lengthy report of its proceedings for the year ended March 31st, 1899. On the question of tramways, it says that by the London United Tramways Bill it was proposed, among other things, to repeal Sections 17 to 28 of the London United Tramways Order, 1895, relative to the use of mechanical power, and it was also proposed to authorise the use of electrical traction upon the whole of the company's system, which extends not only within but outside the County of London, and for this purpose, among other things, to place poles to carry wires over the streets. The Council, while it has not offered objection to the use of the conduit system of electrical traction, has consistently refused consent to the introduction into any part of the county of the overhead system. As the undertakers were not prepared to accept the terms of the Council, the Council decided to oppose the introduction of the Bill, and the company, in order that the measure might be allowed to proceed, withdrew from it all proposals for the construction of new tramways within the county.

On the subject of the electric meter-testing station, the Committee says the amount of energy supplied to any consumer is, unless otherwise agreed, to be ascertained by means of an appropriate meter, which must be of a construction and pattern approved by the Board of Trade, and must be certified to be so, and to be a correct meter and properly connected with a service line, by an inspector appointed by the Council. This is the case with regard to most of the electric lighting orders under which energy is supplied in London. It does not apply, however, in the cases of the St. Pancras (Middlesex) Electric Lighting Order, 1883, and the St. Luke's, Chelsea, Electric Lighting Order, 1891, under which application has to be made to a court of summary jurisdiction to appoint an inspector to settle any dispute. This has been the cause of some inconvenience to consumers in the past, although in some cases the Council's inspectors have, by consent of both parties, adjudicated upon disputes arising outside its area of jurisdiction. For the purpose of meter-testing the Council maintains a testing station, with the necessary appliances for testing meters of all patterns up to a capacity of 600 amperes, at Nos. 42 and 43, Cranbourne Street; and qualified inspectors are engaged there in testing meters. In 1887 the Board of Trade intimated its approval of two patterns of meters, viz., the Ferranti meter and the Hookham meter for continuous current, and in 1899 the self-winding Aron meter for continuous and alternating current; and these, with the Shallenberger meter for alternating current, are the only meters approved by the Board of Trade. The Council has adopted rules and scales of fees with regard to the testing of electricity meters and to other services under the Electric Lighting Acts and orders, and these rules and fees have been approved by the Board of Trade. The Council's officers have for many months been engaged, in conjunction with the officers of the Board of Trade, in the examination of various meters, and the noting of their performance under ordinary working conditions. Thirty-six meters have been under observation for this purpose, and these have been tested at Cranbourne Street before being fixed at consumers' premises. During the year 279 meters of various patterns, the accuracy of which was in dispute, have been tested at the station, and all of these have also been examined at the consumers' premises; 444 meters have been tested for electric supply companies and found to be correct, and sealed accordingly; and 368 tests have been made for meter manufacturers. The amount of the fees received during the year 1898-9 was £387 3s. 5d. This sum does not, however, include anything for the Board of Trade meter-tests, for which no charge is made.

The Council has, since the date of the last annual report, received and dealt with about 290 notices, some of which referred to works extending over large areas; and each of these notices has been separately considered, and, in nearly all cases, special conditions have been attached to the Council's consent. The Council has, during the year, sanctioned the laying of mains in about 132 miles of streets and roads, in addition to a very large number of service lines to consumers' premises. Of these mains, those in 55 miles of streets were for currents of high tension, and in 77 miles for those of low tension. The Council has in all cases required that the mains should be laid under the footways wherever it was found practicable to do so, and that the covers of the street boxes should consist of iron frames filled in with material to suit the paving. The Council also requires that where high-tension mains other than concentric cables are used, each of the street boxes shall be provided with an inner as well as an outer cover, the two being insulated from each other as far as practicable, the outer cover being efficiently connected to earth, and that adequate precautions shall be taken to prevent the accumulation of gas in the boxes and conduits, and any risk of accident through defective insulation of mains.

An official is employed to inspect the works of the companies in the public streets, in order to see that the requirements of the Council are complied with.

As stated in previous reports, a system of supply has been adopted under some electric lighting orders, which involves the construction of transformer boxes or converting stations of very large dimensions to be placed under the public thoroughfares. The Council has, during this year, again taken exception to proposals for the appropriation of large portions of the space under the streets for this purpose, there being, in its opinion, no necessity for such appropriation, as the requisite provision might be made upon private ground. The Board of Trade has, however, as in former cases, overruled the Council's objections, and the Council has, in consequence, when dealing with applications of this nature, given its consent upon the conditions laid down by the Board of Trade in deciding on the cases submitted to it on appeal by the companies concerned.

The Council requires that, in connection with any notices for the construction of transformer boxes, full particulars and plans shall be supplied, showing the exact position to be occupied by, and the internal and external dimensions of, each of the boxes proposed to be constructed, and also the existing works which will be disturbed thereby.

The Council was empowered by its General Powers Act, 1893, to establish an installation for the electric lighting of the Victoria Embankment and the Westminster and Waterloo Bridges. Since the passing of the Act the Charing Cross and Strand Electricity Supply Corporation has obtained permission to lay its mains across Waterloo Bridge, upon condition that the corporation do supply light to the lamps of the bridge and maintain them free of cost, and the terms of this arrangement have been embodied in an agreement prepared by the solicitor. Provision for the lighting of Waterloo Bridge having thus been made, it was necessary to provide only an installation for the other bridge and the Embankment.

The Council has adopted a scheme in which provision is made for 144 arc lamps, to be distributed as follows:—

Victoria Embankment, &c.:—		
On the kerb of the carriageway (land side)	28	
" " " (river side)... ...	29	
" parapet wall	64	
" Northumberland Avenue approach, &c. ...	8	
	—	129
Piers adjacent to the Embankment		5
Westminster Bridge and approaches		10
		144

The lamps on each side of the carriageway of the Embankment are to be about 240 feet from each other, and those on the parapet wall about 66 feet apart, while those on Westminster Bridge and Northumberland Avenue approach will be placed at convenient distances. The whole of the parapet lamps and the alternate lamps on each kerb of the Embankment, and also some of the lamps on Westminster Bridge, will be extinguished at midnight, thus decreasing to an appreciable extent the cost of maintenance. It may be mentioned that the parapet gas lights now in use are extinguished at midnight, so that what is proposed would in this respect be no departure from the present practice.

As regards the plant, it may be stated that by the provision of forced draught the necessity for a chimney at the generating station will be avoided; and that, should the Council at any time decide to light all or any of its subways by electricity, the machinery would be sufficient for the purpose.

The capital expenditure for the installation, according to the estimate submitted to the Council, will probably be about £25,300, made up as follows:—

Buildings	£6,900
Boilers and machinery	9,600
Mains	4,200
Lamps, standards, &c.	4,300
Salaries	300
	£25,300

The probable annual cost of maintenance is estimated at £3,509, made up as shown below, the amount of the capital charges being calculated on the repayment of capital cost being spread over a period of 42 years, the length of time allowed by the Council for repayment of loans to London local authorities for similar works:—

Maintenance	£2,387
Rates and taxes	110
Capital charges	1,012
	£3,509

The Council has accepted the tender of Messrs. McClure & Whitfield, amounting to £3,726 5s., for the supply of the dynamos, and of Messrs. J. E. H. Andrew & Co., amounting to £2,100, for the supply of gas engines, required in connection with the installation, and these portions of the work will shortly be proceeded with.

NOTES.

The Scarcity of Paraffin Wax.—The prevailing scarcity of paraffin wax seems likely to become a matter of some seriousness to the makers of electrical conductors in this country. The importance is all the greater in view of the rapidly increasing demand for this product, the requirements now amounting to double the available supply. About one-half the supply of oil coming to this country is Russian and the other half American and Rangoon, but as paraffin wax cannot be obtained from Russian oil, one has to look for a remedy for the present situation by endeavouring to cultivate the importation of American wax to this country. We are not aware what may be the difficulties, if any, standing in the way of such a development, but we should think it would be worth the while of American traders to give the matter attention.

Charterhouse Science and Technical Schools and Rogers' Memorial Institute.—The winter session of this, one of the largest and oldest science schools in the United Kingdom, will commence on Saturday, September 23rd, 1899, under the presidency of the Rev. H. Swann, M.A. During the late session a large number of students availed themselves of the privileges afforded by this institution, and of these (who were mostly elementary teachers) the majority presented themselves for examination. Instruction of a practical character is given in most of the sciences at a very nominal fee. Those who have leisure can attend, at a very moderate charge, the day science classes. Day classes will also be held to prepare candidates for matriculation (London), clerical, medical (including dental), legal, and other examinations. Students who aim at becoming proficient in physics and chemistry have the opportunity of working in well-fitted laboratories. During the session artizans, apprentices, improvers and others will have the privilege of attending the London County Council technical classes. Full particulars of the classes may be obtained from C. Smith, organising secretary. Those interested in education will rejoice to learn that the work commenced by the late Rev. W. Rogers, M.A., and ably continued by the late Rev. John Rodgers (formerly vice-chairman of the London school) is so vigorously continued by the present president and committee.

Steinmetz, of the General Electric Company of America.—The name Steinmetz is one that future generations will have cause to remember on account of his brilliant experimental work in electrical science. He is of German birth, and was educated partly in Germany and partly at the Zurich Polytechnic. When quite a young man he was exiled from the Fatherland on account of Anarchistic writings, but his ideas on social relations and government have been considerably modified since then. Steinmetz is always smoking, and there is a characteristic story to the effect that when the directors issued a regulation prohibiting smoking in the Schenectady works, he wrote them that if such a bye-law was enforced he should stay at home. Needless to say, an exception was made in his case. The subject of our sketch is a cripple, but rides a specially made bicycle, which enables him to pursue his studies out of doors in natural history and mineralogy.

Another Strike!—An American exchange says it is reported that the "punkah pullers" in West Borneo are in revolt because the Rajah of Koti has bought $30,000 worth of electric fans, and the coolies who formerly worked fans, or punkahs, by hand, will now be out of a job.

Commemoration at Como of the Discovery of the Voltaic Pile.—The recent fire at the Como Exhibition, which destroyed many of the relics of Volta, is not to be allowed to stop the celebration of the centenary of the discovery of the battery. Another exhibition has been organised, and a Congress of electricians is to be held at Como during the current month to read and listen to papers on electrical matters, and to do honour to Volta. We have received a circular giving information about the arrangements. The Congress has been organised by two societies acting conjointly, the Associazione Elettrotechnica Italiana, and the Societa Italiana di Fisica. It is to be opened on September 18th by Prof. Augusto Righi, of Bologna, with an address commemorative of Volta, and will last a week. Papers are to be read, and there will be dinners, *fêtes*, a reception, visits to the tomb of Volta, and to neighbouring electrical installations. A competition in electrical science for a prize of L.3,000, presented by gentlemen of Como, is to be arranged by the committee, but the details are not announced. The principal papers to be read are the following:—

Prof. P. Blaserna.—"On the Disturbances produced in Galvanometers by Electric Tramways."
" " "On the Secular Variations of the Magnetic Inclination in Ancient Times."
Prof. S. P. Thompson.—"Magnetic Images and their Application to the Theory of Motors with Revolving Fields."
Prof. G. Grassi.—"Studies and Experiments on the Transformation of Triphase into Monophase Currents."
Signor G. Semenza.—"The Practice of Electrical Transmission at High Voltage."
Profs L. Donati and G. Grassi will introduce a discussion on electrical terminology.

The president of the Executive Council is Prof. Giuseppe Colombo, the vice-presidents are Prof. P. Blaserna and Prof. G. B. Cadenazzi, and the secretary is Signor Alessandro Panzaresa. The address of the committee is Via S. Paolo, 10. Milan. The general programme is as follows:—

September 18th	10 p.m.	—Inauguration of the Congress. Commemoration of Alessandro Volta by Prof. Augusto Righi.
"	7 0 p.m.	—Dinner given by the members of the Congress to foreign electricians and other distinguished persons.
" 19th.	9 0 a.m.	—General sessions of the Congress.
"	2 0 p.m.	—" " " "
" 20th.		—*Fête* on the Lake given by the city of Como.
"	9.0 p.m.	—Grand Venetian illumination of the city of Como, arranged by the Executive Committee of the Exhibition in honour of the electricians.
" 21st.	9.0 a.m.	—Meeting of the two organising societies.
	2 0 p.m.	—" " "
"	7.0 p.m.	—Dinner given by the Prefect of Como, Comm. Felice Segrè.
" 22nd.	Morning.	—Visit to the tomb of Volta.
"	2 0 p.m.	—Meeting of the two organising societies.
" 23rd.	9.0 a.m.	—" " " "
"	2.0 p.m.	—General session and close of the Congress.
"	9.0 p.m.	—Reception and Concert at the Casino.
" 25th, 26th.		—Excursions to the electrical works at Paderno, Milan, and Vizzola.

Sir W. H. Preece's Wireless Telephony.—It is stated by the *Carnarvon and Denbigh Herald* that for some weeks past experiments of great interest in wireless telephony have been carried on by Sir W. H. Preece near Carnarvon. As a matter of fact it is telegraphy, not telephony, which Sir W. H. Preece has been working on, telegraphy on what may be called the "buzz r" Morse system, a telephone being used as a receiver. All the London papers have naturally fallen into the same error as is their wont.

A Large Electric Traveller.—Our New York namesake says that the largest electric travelling crane ever designed is to be built in Milwaukee, Wis., for a leading Philadelphia plant. It will be of 150 tons capacity. There are other 150-ton cranes, using 75-ton trolleys, but this crane will have one 150-ton main trolley, with a test load of 200 tons, and an auxiliary trolley of 25 tons capacity.

The British Association.—The Dover meeting, although not the smallest by two or three, promises to be exceedingly small in numbers, for up to Wednesday night only 1,216 names were registered. In Section A the proceedings yesterday, after the presidential address, should have been papers by Dr. Bauer, on "Recent Magnetic Work in North America," and the presentation of a report on the "Methods of Determining Magnetic Force at Sea," but the paper was not read nor the report presented. The Sectional Addresses were well received, especially Sir W. White's on "Steamships." Sir E. Carbutt and Sir W. H. Preece proposed votes of thanks. In the physiology section a report on the "Electrical Changes Accompanying the Discharge of the Respiratory Centre," was read. In the chemistry section, Prof. Dewar read a paper on the "Solidification of Hydrogen."

Brighton System.—The following comes to hand as we go to press:—"Will you kindly give me a simple explanation of the system of charging for current known as *the Brighton system?* Also an illustration of, say, 20 16-C.P. lamps burning an average of four hours per night. I shall esteem your answer a great favour, as I have asked so many times and always got different answers.—Yours truly, CURRENT."

[We refer our correspondent to an article on this subject in our issue of November 6th, 1896, p. 595.—EDS. ELEC. REV.]

Appointments Vacant.—The Watford Council wants a junior assistant engineer. See "Official Notices" this week.

The York Electric Lighting Committee wants an assistant electrical engineer and other members of the staff for the electric lighting works. See "Official Notices" this week.

The Corporation of Newport (Mon.) wants an electrical engineer with experience in alternating current stations, at a salary of £2 per week; also a mains superintendent with a thorough knowledge of sub-stations, transformers, &c. See our "Official Notices."

Two assistants are required in the electrical engineering department of the Central Technical College, City and Guilds of London Institute. Salary, £100 per annum. See our "Official Notices."

The Institution of Electrical Engineers' Reunion in Switzerland.—On Wednesday last week the first annual summer meeting of the Institution was held at the Polytechnikum, and was followed by a lunch given to the Swiss Association and other friends at the Tonhalle. In the afternoon the Polytechnikum was visited; the party afterwards proceeded to Lucerne. On Thursday most of the members travelled by the Stansstad-Engelberg Electric Railway to Engelberg, and then went on to Interlaken, *viâ* the Brünig Pass, one of the most interesting and enjoyable experiences of the tour. The Jungfrau Electric Railway was inspected on the following day, amid magnificent surroundings, and on Saturday the tour concluded with a visit to the Burgdorf-Thun Electric Railway. Many of the visitors remained in the neighbourhood of Interlaken, to rest after their exertions; others went to Como, some to Paris, but the majority returned home on Saturday and Sunday. It was agreed on all hands that the tour had been most successful, and it is highly probable that a similar excursion will be made next year, in response to Dr. Rathenau's generous invitation, to the works of the Allgemeine Elektrizitäts Gesellschaft, at Berlin, and to other places of interest in that district. We hope to give our readers a full account of the whole of the proceedings in future issues.

Accident to the P.O. Pneumatic Tubes.—Hundreds of important telegrams were delayed at St. Martin's-le-Grand one day towards the end of last week. A number of carriers became blocked in one of the tubes. It was about five hours, says the *Daily Mail*, before the telegrams were released and sent on their way.

Electrical Resistance of Human Blood.—In a recent communication to *Nature*, Dr Dawson Turner says that it is not easy to measure the electrical resistance of the blood of a living person. His best results were obtained by placing five cubic millimetres of freshly drawn blood between two cup-shaped electrodes three millimetres in diameter, coated with spongy platinum, and fixed ·75 millimetre apart. He says that the average resistance of normal blood at 60° Fahr. measured by Kohlrausch's method is 550 ohms; but an observation which may be of great value to the physician is appended: "A striking change may be observed in pernicious anæmia, the resistance in this disease being sometimes diminished to about one-half that of normal blood. It is suggested that the blood contains an abnormal amount of salts.

"Welcome, Dewey!"—When Admiral Dewey arrives at New York Harbour on September 28th, he will find the place rich in electrical illuminations in honour of his return. We read in a New York exchange that the displays will exceed anything ever before seen in New York. The great span between New York and Brooklyn will shine out a "Welcome, Dewey," in letters 36 feet high. The legend will be 300 feet long, and more than 8,000 high C.P. incandescent lamps will be used in it. There are to be "Welcome" legends on a smaller scale, and other electrical illuminations everywhere.

Electric Locomotives for Japan.—The *Engineer* says that two electric locomotives have recently been supplied, by an American firm, to the Japanese Government. They will be used in coal mines. Their height from the rail, exclusive of the trolley, is 2 feet 10 inches; width, 4 feet 2 inches; and length over buffers, 11 feet 8 inches. Each locomotive complete weighs 12,050 lbs., and is of 20 H.P., to run at a speed of 8 miles an hour.

NEW COMPANY REGISTERED.

Pulford Brothers, Limited (63,544).—This company was registered on September 8th, with a capital of £3,000 in £1 shares, to acquire and take over as a going concern the business of an electrical engineer, now carried on by Egerton G. Pulford at Moorfields and Brooks Alley, in the City of Liverpool, and to carry on the business of manufacturers of and dealers in electric lamps, electricity meters, electrical switches, cut-outs, and all kinds of apparatus, machinery and appliances, capable of being used in connection with the generation, storage and utilisation of electricity or other force; cycle and carriage makers, ironfounders, saddlers, platers, japanners, annealers, galvanisers, &c. The first subscribers (each with one share) are:—Egerton G. Pulford, 15, Moorfields, Liverpool, electrical engineer; John Macleod, 41, Upton Road, Birkenhead, engineer; John Macleod, 41, Upton Road, Birkenhead, manager; Miss Mary C. Macleod, 41, Upton Road, Birkenhead; Miss Maggie S. Macleod, 41, Upton Road, Birkenhead; John H. Buyer, Exchange Chambers, Bixteth Street, Liverpool, warehouse owner; Daniel Higson, 36, Dale Street, Liverpool, solicitor; and Mrs. Elizabeth Pulford, 34, Grove Road, Rock Ferry. The number of directors is not to be less than two nor more than five; the first are Egerton G. Pulford and John Macleod, jun.; qualification, 250 shares; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Greenwood and Batley, Limited (27,098).—This company's annual return was filed on July 24th, when 11,066 preference and 18,052 ordinary shares were taken up out of a capital of £400,000, in 14,000 preference and 26,000 ordinary shares, all of £10 each; £10 has been called on each of 6,934 preference and 12,134 ordinary shares, and £3 on each of 1,466 preference and 1,252 ordinary, resulting in the receipt of £198,834; £73,320 is considered as paid up on 2,666 preference and 4,666 ordinary shares.

Globe Telegraph and Trust Company, Limited (7,465 C).—This company's annual return was filed on August 18th, when 180,042 preference and 180,227 ordinary shares were taken up out of a nominal capital of £5,000,000 in 250,000 preference and 250,000 ordinary shares of £10 each. £10 per share has been called up, and £3,602,690 has been paid.

CITY NOTES.

Huddersfield Corporation Electricity Works Accounts.

Last year, when dealing with the Huddersfield accounts, we referred to the steady and sound progress shown by the results of the working of the business up to the end of the year 1897. We are glad to see that the surplus of 1897 was more than doubled in 1898, and it may be noted that the "surplus" for last year is very nearly the same as the loss for the first year, 1893. The items in the "Costs" show small decreases, with the exception of "Oil, waste, &c.," the total decrease in costs amounting to as much as ¼d. per unit, the increased production or output being over 150,000 units. The total cost per unit has now been reduced to just below 2d.

The following statement shows the general position of the undertaking:—

	1897.	1898.	Increase.
Total capital expenditure	£69,415	£93,494	£24,079
Number of units sold	438,848	593,377	154,529
Number of lamps connected	41,702	54,154	12,450
Gross revenue	£9,060	£11,866	£2,806
Gross profit	£4,964	£6,986	£1,972
Average price per unit sold	4·66d.	4·51d.	−0·15d.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current	£8,533	4·66d.	£11,153	4·51d.	−0·15d.
Meter rents	458	0·25d.	630	0·25d.	...
Supply of lamps	...	...	83	0·04d.	+0·04d.
Sundry fees, &c.	69	0·04d.	...	...	−0·04d.
Gross revenue	£9,060	4·95d.	£11,866	4·80d.	−0·15d.

Cost of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£931	·49d.	£1,170	·47d.	− 02d.
Oil, waste, &c.	104	·06d.	161	·07d.	+ 01d.
Wages	985	·54d.	1,309	·53d.	− 01d.
Repairs, &c.	794	·43d.	840	·34d.	− 09d.
Works' cost..	£2,784	1·52d.	£3,480	1·41d.	−·11d.
Rent, rates, &c...	311	·17d.	317	·13d.	−·04d.
Management, salaries, &c.	1,001	·55d.	677	·27d.	−·10d.
Establishment charges.					
Other expenses..	...	...	455	·18d.	
Total costs	£4,096	2·24d.	£4,929	1·99d.	− 25d.

Profit Statement.

	1897.	1898.
Interest on loans	£3,780	£2,601
Sinking fund for repayments		1,898
Net profit carried to depreciation	1,184	1,237
„ cost of altering circuit	...	1,200
Gross profit	£4,964	£6,986

The tenth annual general meeting of the shareholders of this company was held on Friday, September 8th, at the Cannon Street Hotel, Mr. J. B. Braithwaite, jun., M.I.E.E., presiding.

The Chairman, in proposing the adoption of the report, said that dealing first with the profit and loss account, which interested the shareholders most, they would see that the company had earned in gross profit £4,392 more than the previous year. Their earnings had been £54,039, against £49,647, and what was very satisfactory was that they had been able to retain the whole, or rather more than the whole, of that increase as net profit. The net profit showed an increase of £4,942. So that, broadly speaking, they might say that the additional profit had been earned without any increase of expenditure. That, he thought, was a very satisfactory thing, and one that they had to congratulate themselves upon last year. If they would look at the various items of expenditure they would see that the total general charges this year were £11,780 18s. 1d. against £11,276 9s. 9d., showing an increase of £500 only, and that £500 was the additional directors' fees, which, as they mentioned last year, they proposed to take, now that the company was earning a dividend on the ordinary stock. They were entitled under the articles to take £2,000, but they did not intend to exercise that right to the full. On the maintenance of buildings and plant they had spent £4,438—rather more than last year—but they must always keep their buildings and plant in first-rate condition, and whatever money they required for that purpose must come out of the revenue. The maintenance of patents had cost them £672, and the sum of £5,625, interest on first debenture stock, was the same as last year. There was £2,425 for interest on the second debenture stock, and an item of £611, being the remainder of the cost of redeeming that stock, which was now extinguished. That left them a balance of £31,880 as against £26,938, showing an increase of just on £5,000. They really had another £1,000 beyond that, because last year they put aside £1,000 out of profits to provide the nucleus for an insurance fund in connection with the Workmen's Compensation Act, and as that sum was not required this year, they really had £5,942 more to distribute. They proposed to deal with that money in the following manner:—Extra dividend to the ordinary shareholders, £3,600, raising their dividend to 5 per cent. for the year. Then, under their profit-sharing scheme, their workmen's bonus fund would require an additional £360, and they proposed to raise their carry-forward to over £5,000. Turning to the balance-sheet they would find some very considerable changes there, due to the rapid extension of their works at Loughborough. On the credit side they would see that, as he intimated to them last year, they had spent a very considerable sum on additions to their plant and machinery—no less than £55,956 during the year, and he told them that over and above that sum, they had been obliged to incur additional liabilities. The fact was that at the present time their business was increasing by leaps and bounds, and it was quite impossible to keep pace with the increase by any extensions they might make at the works. He told them last year that they contemplated the erection of a new car shop. They had pushed on with the erection of that building as fast as possible, for they had orders in hand before the shop was finished, and although it was capable of turning out 250 additional electric cars per annum, they had more orders now than they could turn out. The only consolation they had was that all their competitors were in the same boat, owing to the very rapid increase in the use of electric cars in this country. Taking the next item—stock, that had risen to the extent of £31,926. That, of course, they would expect, and it showed that they had not been extending their works without a *raison d'être*, and if they extended the works still further they must expect that item still further to increase. The debtors had increased by £10,820, which was the natural sequence to the increased trade they were doing. Turning to the debtor side of the balance-sheet, they would see that the capital remained the same. The creditors showed some increase, due to the increase in the business, and corresponding somewhat to the increase of debtors on the other side. The depreciation and reserve fund stood at £10,000, which would be increased to £15,000 after that meeting. The Workmen's Compensation Act insurance fund stood at £1,000, and he might say that the experiment they decided upon in that connection last year had turned out successfully. The insurance companies were quoting rates which appeared to them out of all proportion to the risks incurred under the new Act. They, therefore, decided to become their own insurers and to place £1,000 to a reserve fund for that purpose, and to put aside a certain sum every week. They had done so, and when they came to reckon up the claims which they had to pay during the year, they were so exceedingly small, that they were able to recredit almost the whole of that sum back into the funds. There was one great change in the balance-sheet, viz., that whereas last year they had large sums as cash in hand, this year they owed considerable sums, the turnover in that respect being something like £100,000. That was accounted for by the fact that they had put £55,956 into extensions of the works; they had spent in wages and material on extra work in hand £31,926; they had increased their investments by £5,300, and they were owed £10,820 more than last year. Those figures gave them a total of £104,002, and the effect of that was that it would be necessary for them to find some means of raising some additional capital to pay for further extensions in the works. The industry had developed to such an extent as to render such a course prudent and advisable. At the present time they had three to five years' work ahead of them and it therefore became the duty of the directors to see who would be the most

Comparative Annual Statement from the Commencement of the Undertaking.

Year ended	No. of consumers.	No. of 8-c.p. lamps connected.	B.T. units sold.	Income.	Expenditure.	Balance. Deficiency paid from borough fund.	Balance. Surplus.	Rate in £.
				£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.
Dec. 31st, 1893...	112	9,613	43,224	1,067 3 11	3,614 11 8	2,547 0 0	...	1 9/16
„ „ 1894...	214	15,342	156,169	3,560 8 7	5,625 13 4	2,065 0 0	...	1 1/4
„ „ 1895...	280	20,689	227,753	5,351 5 0	6,724 9 0	1,373 0 0	...	0 7/8
„ „ 1896...	385	28,983	304,163	6,864 2 5	6,429 13 4	...	434 9 1	Transferred to depreciation and contingencies account.
„ „ 1897...	598	41,702	438,648	9,060 12 1	7,876 12 1	...	1,184 0 0	
„ „ 1898...	806	54,154	593,377	11,866 11 2	9,429 9 11	...	2,437 1 3	

prudent method of raising the necessary money to carry out these extra extensions at Loughborough. They thought that the time had arrived when they should pay off the remaining 50,000 second debenture stock, which was bearing 4½ per cent. interest, and issue in its place £125,000 4 per cent. debenture stock, which would rank after the existing 4½ per cent. perpetual debenture stock. If they did that, they would obtain £25,000 extra capital at a cost of £500 per annum, in other words, at 2 per cent. They proposed to make that issue about the middle of next month, and they would take care that the present shareholders would have a good opportunity for subscribing for their share of that stock. They were using their best endeavours to spend the money wisely in additions to the works and in endeavouring to avoid creating large shops which would be on their hands if the tide of business should turn. In conclusion, the chairman referred to the new dynamo that the company was introducing—the inductor, in which both the field magnets and the armature coils were fixed. They had, he said, great hopes of the machine, because all who had seen it thought very highly of its mathematical soundness.

Mr. B. H. Van Tromp seconded the motion, and, after some discussion, the report was adopted.

The City of Carlisle Electric Tramways Company, Limited.

The first ordinary meeting of the shareholders of the above company was held at Manchester on the 7th inst. Mr. T. D. Lingard, the chairmen of the company, presided.

The Chairman said in a company of that sort, where a considerable amount of works had to be constructed before the business of the company was commenced there was practically nothing, or very little, to say. Had it not been for the provisions of the Companies Acts, the directors would not have troubled the shareholders to come together on that occasion. He was happy to say that the flotation of the company was in every way satisfactory. The ordinary shares were considerably over-applied for, and the debenture stock had been placed. The engineers of the company had been successful in satisfying both the local authorities and the Board of Trade as to the details of the construction of the Carlisle tramways. The speaker then read reports from the contractors and engineers of the works, from whom it appeared that matters were proceeding in a satisfactory manner. The contractors wrote that the work would be completed up to time, which was December 31st next.

Kalgoorlie Electric Power and Lighting Company, Limited.—The secretary of this company, whose prospectus was contained in our last issue, writes to the *Times* as follows:—

It has been pointed out to me that the wording of the paragraph in the prospectus of the Kalgoorlie Electric Power and Lighting Corporation, Limited, dealing with the report of Prof. George Forbes, F.R.S., may be construed to mean that in addition to having exhaustively reported upon the merits of this undertaking, he also personally made a local examination. My directors do not admit this inference, and it was not so intended, as Prof. Forbes made his report upon materials furnished to him, as explained in the report itself, which can be seen at the office of the company's solicitors.

Stock Exchange Notices.—Application has been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to—Charing Cross and Strand Electricity Supply Corporation, Limited.—Further issue of 20,000 ordinary shares of £5 each.

Royal Electric Company of Montreal.—The directors have declared a dividend of 2 per cent. for the quarter ended August 31st, being at the rate of 8 per cent. per annum, payable on October 2nd.

W. T. Henley's Telegraph Works Company, Limited.—Letters of allotment and regret have been posted for the issue of the 4½ per cent. preference shares, which was largely over subscribed.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending September 9th, 1899, were £1,335 17s. 9d.; receipts for week ending September 9th, 1898, £1,119 14s. 5d.; aggregate for half-year to date, £14,798 2s. 7d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending September 8th, 1899, were £3,697 12s. 3d.; corresponding period 1898, £3,443 1s. 2d.; increase, £254 11s. 1d.

The City and South London Railway Company.—The receipts for the week ending September 10th, 1899, were £886; week ending September 11th, 1898, £876; increase, £10. Total receipts for half-year, 1899, £10,418; total receipts corresponding period, 1898, £10,487, decrease, £69. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending September 9th, 1899, were £293 13s. 4d.; week ending September 10th, 1898, £244 10s. 8d.; increase, £49 2s. 8d. Total receipts to date, 1899, £7,074 19s. 0d.; corresponding period, 1898, £5,750 1s. 3d.; increase, £1,324 17s. 9d. Miles of track open, 1899, 3; 1898, 3. Car miles run, 1899, 4,916; 1898, 3,807. Number of cars, 1899, 12; 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, September 8th, 1899, were as follows:—D. U. T. Co., horse cars, £1,370 3s. 9d.; ditto, electric cars, £2,189 9s. 5d.; D. S. D. Co., electric cars, £1,050 13s. 9d.; total, £4,560 6s. 11d.; corresponding week last year—D. U. T. Co., horse cars, £2,886 5s. 6d.; ditto, electric cars, £604 12s. 7d.; D. S. D. Co., electric cars, £1,213 18s. 8d.; total, £4,704 16s 9d.; decrease, £144 9s. 10d. Aggregate to date, £47,283 15s. 7d.; aggregate to date last year, £45,889 7s. 11d.; increase to date, £1,444 7s. 8d. Worked:—The mileage open is 25 miles electrically, 19 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending September 10th, 1899, were £750. Miles of track open, 10. Car miles run, 11,531. Number of cars, 21. The receipts for the week ending September 14th, 1898, were £806. Miles of track open, 8½. Car miles run, 8,723. Number of cars, 10. Total receipts to date, 1899, from April 1st, 1899, £13,913; total receipts to date, 1898, from June 29th, 1898, £8,138.

The Liverpool Overhead Railway Company.—The receipts for the week ending September 10th, 1899, amounted to £1,614; corresponding week last year £1,528; increase, £86.

The South Staffordshire Tramways Company.—The receipts for week ending September 8th, 1899, were £722 12s. 1d.; aggregate receipts for 36 weeks, £23,940 15s. 10d.; week ending September 9th, 1898, £739 10s. 2d.; aggregate receipts for 36 weeks, £22,657 17s. 5d.

STOCKS AND SHARES.

Wednesday Evening.

A cheerful mind shrinks from the melancholy task that faces it this week in writing the usual Market Notes. Falls have to be recorded in almost every instance where there is any change to report at all. Not that there are very many alterations, however, and some little consolation must be derived by shareholders of the unchanged securities at the strength displayed by their stocks, considering that the Stock Exchange generally has been so shaken in every department. A recovery from its gloomiest mood gave the House more confidence on Tuesday, and it is quite certain that the majority of members will not believe in war until the first shot has been fired by the Boers. Nevertheless, the tension continues, and the heavy fall in the mining markets has caused some realising of electric and kindred shares by people in want of money wherewith to meet their engagements in Kaffirs and Kangaroos.

The electricity supply section has seen its Metropolitan companies' prices sag daily. Citys are exceptional in maintaining their ground, but the market is flabby and dull. Westminsters blazed up at the end of last week, some fairly good buying taking place in a market short of shares, but immediately the broker had been accommodated the quotation slipped back again, and now is even 10s. down on the week.

The Royal Electric Company, a Canadian concern, declares its usual dividend of 2 per cent. for the quarter. The hundred-dollar shares stand at 170, and the price of the 4½ per cent. Debentures is 106. Very little market exists in London for either description of stock, the Montreal Exchange doing what small amount of business there is in them. The company has a contract with the Corporation of Montreal city for electric lighting until 1904, at an average price of about £24 per lamp per annum. We have not yet heard of any proposal to cancel the agreement by the Corporation.

Decidedly interesting is the new Kalgoorlie Electric Power and Lighting Corporation, whose prospectus appeared in our columns last week. The issue of £150,000 Preferred shares of £1 each offers a fair field as a speculative investment. We certainly consider that the purchase price, £25,000 in Deferred shares, is plenty of money, but as the whole of the new emission is to be set aside for working capital, and as the shares issued to the public are preferential, both as to capital and interest, there is not much ground for cavilling. The shares are being dealt in to a small extent by the West Australian mining market, and there is the pro-allotment premium of $\frac{3}{16}$ per share quoted, which we hope will not run off.

Telegraph stocks are inclined to weakness. Eastern Ordinary has shed another brace of points, and now stands lower than it has been since 1894, when the price of the £10 shares fell to 14¾, equal to 147½ of to-day's stock. The fears of fighting in South Africa have led to some inquiry for the stocks of those other African lines which are not likely to be injured by the outbreak of hostilities. West African 5 per cent. Debentures are 1 up. There has been some inquiry for Western and Brazilian 4 per cent. Debenture stock. Anglo-American issues fell upon the news that Cornelius Vanderbilt was dead, it being almost invariably the case that a sudden fall in Yankee rails brings a corresponding drop in Anglo "A" and "B." Otherwise the telegraph market is without feature.

Oriental telephones weakened a trifle at the advent of a small seller. Nationals remain quiescent; the rate for contangoing the shares to-day (Wednesday) has been about 3d., and the making up price 5¼, as against 5⅜ of a fortnight ago.

The Tramways Union Company has voluntarily wound itself up, and nothing remains for the directors to do beyond realising the Bremen asset. As we foreshadowed last week, this will probably mean the return of another 70s. per share to holders. Another company which is thinking of retirement from the toils of public life, is the Paris Omnibus Company, which, it is stated, is considering the offer made by a traction concern that the latter shall take over and electrify the whole of the present tram system in Paris. There ought to be money in the scheme, considering the immense advantage which an electrical service would possess over that at present worked by what are politely called horses.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, September 6th.	Closing Quotation, Sept. 13th.	Business done during week ended Sept. 13th, 1899. Highest.	Lowest
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	63 — 66	63 — 66	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	115 —116	114½—115½	115½	114½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14½— 15	14½— 14⅝	14⅝	14½
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	14⅝— 15½	15⅛	14⅝
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105	104⅜
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½%	1 %	⅜— ½	⅜— ½	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9½	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11⅜— 12½	11⅜— 12½	11⅞	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	1⁰ 2½	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	151 —156	149 —154	152½	149½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	99½	99½
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	116 —121	116 —121	119⅜	116⅜
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 14⅝	14½— 14⅝	14 9/16	14½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	100½	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	115 —120	115 —120	118⅜	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	100½	...
800,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	103	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5½%	10⅜— 11½	10⅜— 11½	10 1/16	10⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½	15 1/16	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	30½	30
93,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	49	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109 xd	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ⅛	¼— ⅛	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	⅜— 1	⅜— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	5 5/16	5 3/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	5 5/16	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —102	99 —102	100¾	99¾
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7⅞	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	4⅞	...
151,783£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	98 —101 xd	99 —102	101⅜	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	104 —107	106	105
88,321	West India and Panama Telegraph	10	1 %	2%	...	1⅜— 1⅝	1⅜— 1⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	9⅛	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103 xd	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10½— 11½	10 — 11	10⅜	10⅛
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	113 —115	113 —115	113	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11½— 12½	11½— 12½	12	11⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13¼	12¾
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	127½	...
40,000	County of Lond. & Brush Prov. Elec. Lig., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 12	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13½— 14½	...	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	82 — 85	82 — 85	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5 — 5½	5 — 5½	5⅛	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9	8 — 9	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	14½— 15½	15⅛	14⅜
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16½— 17½	16½— 17½	16⅞	16 11/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4½	3⅞— 4½	4	3 15/16
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15½— 16½	15 —16	15 3/16	15 7/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Sept. 6th.	Closing Quotation Sept. 13th.	Business done during week ended Sept. 13th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2¾— 3¼	2¾— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	97 —102	97 —102	...	...
30,000	British Electric Traction	10	...	...	6 %	17½— 18½	17½— 18½	18	17¼
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13⅜— 14⅛	13⅜— 14⅛	14⅛	13 15/16
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	...	...	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6¼— 6⅝	6¼— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅝— 2⅛	1⅝— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2 5/16	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	108 —112 xd	108 —112	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13½— 14½	14¼	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10¾	10¼— 10¾	10¾	...
178,303	Do. do. do. £8 paid ...	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
71,447	Do. do. Def. do.	5	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
630,000£	City and South London Railway	Stock	1 1/16 %	1⅞ %	2⅛ %	65 — 67	65 — 67	66	65½
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼— 6⅜	6¼— 6⅜	6⅜	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¼— 4	3¼— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2¼— 2⅜	2¼— 2⅜	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3⅛	3 — 3⅛	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅜	21
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	7⅞— 8	7⅞— 8⅛	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13⅝	13½— 13¾	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	37 — 41	38⅜	37½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	5⅞	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	...	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8½—9½.
British Aluminium, Ordinary, 9½—10; 7 % Pref., 10—11.
House-to-House, 4½ % Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 2—4.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7⅝. Debentures, 106—109. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 19.

Bank rate of discount 3½ per cent. (July 13th, 1899).

MARKET QUOTATIONS, Wednesday, September 13th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	22/-	22/-	..
a " Oxalic	per cwt.	32/-	32/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	35/-	35/-	..
a Ammonia, Muriate (crystal) ..	per ton	£25	£25	..
a " "	per ton	£23	£23	..
a Bleaching powder	per ton	£5 15	£5 15	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a " (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£24	£23 10	10s. inc.
a Lead, Nitrate	per ton	£23 10	£23 10	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8½d.	8½d.	..
a " Caustic (75/80 %) ..	per ton	£24	£24	..
a " Bisulphate	per ton	£25	£25	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£7 10	£7 10	..
a " Crystals	per ton	£3	£3	..
a " Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b " Sheet, in ton lots..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2' to 12') basis	per lb.	8½d.	8½d.	..
c " Tube (brazed)	per lb.	10½d.	10½d.	..
c " Wire, basis	per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
f Ebonite Rod	per lb.	3/-	3/-	..
f " Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£88	£88	..
g " Wire (basis price) ..	per lb.	10½d.	10½d.	..
g " Sheet	per ton	£88	£88	..
g " Rod	per ton	£88	£88	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	6/-	6/-	..
h India-rubber, Para fine ..	per lb.	4/2½	4/2 to 4/3½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants)	per ton	67/4½ to 69/7	67/6	..
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 ..	per ton	£12 17 6	£12 17 6	..
g Lead, English Ingot	per ton	£15 5	£14 18 9	6/3 inc.
g " " Sheet	per ton	£15 7 6	£15 7	..
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£8 12	£8 12	..
d Mica (in original cases), small	per lb.	2d. to 6d.	2d. to 6d.	..
d " " " medium	per lb.	1/9 to 2/6	1/9 to 2/6	..
d " " " large	per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd strip & sheet	per lb.	From 1/2½	From 1/2½	..
o Platinum	per oz.	£3 10	£3 10	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15 to £40		..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£149 10	£146 10	£3 inc.
g " foil	per lb.	1/6	1/6	..
n " wire Nos. 1 to 16	per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	7½d.	7½d.	..
j " Best Flax, 6 lea. ..	per lb.	4½d.	4½d.	..
j " Hemp, 3 ply 10 lbs. ..	per lb.	3½d.	3½d.	..
j " " Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove ..	per ton	£13	£13	..
j " Manila, 24 thread ..	per ton	£56 10	£35 10	£1 inc.
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£27	£27	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

THE SYNCHRONISING OF ALTERNATORS.*

By M. GARDNER and R. P. HOWGRAVE-GRAHAM.

(*Concluded from page* 417.)

We will now deal with a few of the methods of connection of synchronising apparatus which depend on the same principle as the method just described. In (fig. 4) the primary, P, of a transformer is put where the lamps were in the former case, and one or more lamps are put in series with the secondary, S. This, of course, is for high tension systems, where it is impossible to put lamps straight on to the machines.

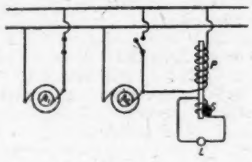


Fig. 4.

Fig. 5 shows a method in which a transformer, with two primaries, is used, one being connected to the bus bars or to A_1, and the other to A_2. This method has the advantage of admitting of the use of a double-pole switch. The arrows show the directions of the electromotive forces and magnetomotive forces at the right moment for switching in. Another way is to have two entirely separate transformers, the primary of one being connected to the bus bars, and that of the other to the machine to be thrown in, as in fig. 6.

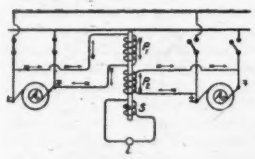


Fig. 5

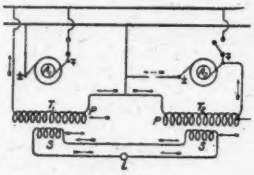


Fig. 6.

If the secondaries are connected in series, the moment for switching in will be that of minimum light. If the secondaries are cross-connected, it will be that of maximum light. The substitution of telephones for lamps was introduced by the General Electric Company. They did not use ordinary telephones but large iron-wire-cored electro-magnets with iron diaphragms in front. They had them quite separate, one to each machine, either with or without transformers, according to the voltage.

These sounders simply howled, and when the machines were getting into synchronism, the sound waves interfered with each other, and beats were produced, rapid at first, but getting slower and slower.

When the note was clear and steady, it was known that the machines were in synchronism, and they were switched in, though they might be ever so much out of phase, and we have spoken of how disastrous this may be. However, it is clear that we can use a single telephone in place of the lamp or lamps in any of the pilot lamp methods described, and that then we may be sure of synchronism and step by switching in when the sound is at a minimum.

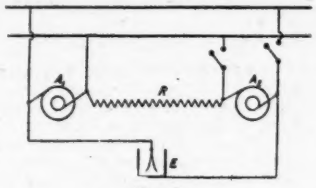


Fig. 7.

I have a telephone here which I can substitute for the lamp in this revolving commutator model. A Cardew voltmeter is a very present help in time of trouble, if used instead of, or even as well as, an incandescent lamp. It reads quite quickly enough, and the exact position of the needle, as it slowly oscillates, is easy to follow, while the exact brilliance of a lamp is difficult to judge, owing to eye fatigue.

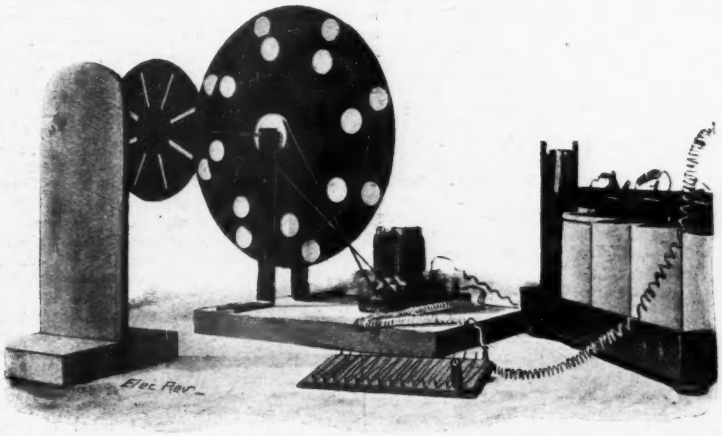
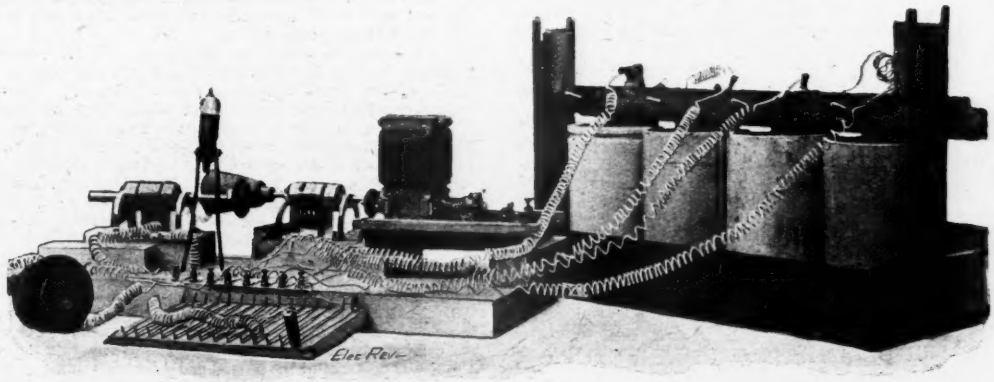


Fig. 8.

Prof. Ayrton mentioned at the Institution of Electrical Engineers in 1894, an electrostatic synchroniser, for the purpose of doing away with transformers in high tension stations. A diagram of connections is shown on the board (fig. 7):—R was to be a resistance, almost as large as you like, say a thin lead pencil line on a piece of slate or carbonite. E was to be any dead-beat electrostatic voltmeter, such as a gold leaf electroscope, which might be made with leaves even a foot and a half long, to be visible all over the station. In such an apparatus the moment for switching in is when the leaves stay closed



Illustrative Model.—See page 416 ante.

* Read before a meeting of the students of the Institution of Electrical Engineers on Wednesday, March 22nd, 1899.

for some time. Prof. Ayrton claimed that an electrostatic arrangement like this is more dead-beat than a lamp, the luminosity of which remains. He maintained, also, that it is cheaper than the ordinary methods, as it does not involve the use of somewhat expensive transformers, and that it may be as large as you like, and needs no accurate calibration and no scale, and, as an electrostatic voltmeter, may be as wrong as you like, and, lastly, that it is perfectly and absolutely safe.

Sometimes little auxiliary synchronising bus bars are provided. Any machine to be synchronised can be connected to them, and the whole thing done as usual, except that when the right moment comes, instead of being switched straight on to the main circuit, it is put on to these bus bars, between which one or more choking coils are placed, through which the machine cannot possibly force more than 10 or 15 amperes. This current is quite sufficient to synchronise it, and when it is seen to be running quietly and steadily it is put on to the main circuit by a second switch.

Optical Synchronisers.

There is a very curious optical effect made use of in synchronising. It was noticed that if the light from an alternating arc fell upon the alternator lighting it, the fly-wheel appeared to stand still or revolve very slowly, according to the number of spokes in it. Now, if we paint the armature, or revolving part, round with as many spots as there are alternations per revolution, and light it from an arc overhead driven by itself (we mean the armature's self, not the arc's), a spot which we will call A, which is in front of one which we shall call B, will be illuminated when the pulsating light is at its maximum. B will also be illuminated as will all the other spots round the armature.

The light will now die down a little, and by the time the next maximum brightness comes, the spot B will have got to where A was before, and all the other spots will have been shifted on one space. The effect of this will be to make the circle of spots appear stationary. If the same arc lamp lights up another machine similarly painted with spots, and if that other machine is being brought into synchronism, and is running a little bit slower, its spots will appear to slowly rotate backwards, because, instead of moving on one space to each beat of light, if we can call it so, the spots move rather less than one space.

This method is never used for absolute synchronising, but mostly to give the man who is at the engine a rough idea of how the speed is going, while there is a man at an ordinary pilot lamp apparatus as well. The things which appear to happen to the spots as the second machine gradually speeds up, are best seen on this model, where the effects are wonderfully like those on a real machine. I will just roughly describe it.

The large disc (fig. 8) represents the machine already running, is painted round with eight equidistant spots, and rigidly connected to a shaft driven by a motor. At the front end of the shaft there is a small disc, in which eight slots are cut. This disc is also rigidly connected to the shaft, and when a light is placed behind the slots, flashes of light are produced, which imitate the light given out by the alternating arc driven by the dynamo corresponding to the large disc.

The disc between the two others is, as you see, painted with similar white spots, but is loose on the shaft, and when the large disc is revolving we can hold it, and on letting it go, observe the effects, as by friction it gradually gets up to synchronism with the large disc. You will see the spots on the large disc appear to stand still, while those on the smaller one will, after various curious changes, appear to slowly rotate in a direction opposite to that of the real rotation. If the friction were great enough they would finally come to rest.

As regards this method, it will be interesting to quote the words of Dr. Silvanus Thompson in the discussion of Mr. Mordey's paper of 1894, before the revolving spots ever came to be used at all. He says:—

"I remember very well watching the machines built by Gaulard & Co. in the station at Rome."

"The alternators were set in one line."

"You can look through one machine at another, and you can see when the machines are synchronised by merely observing the rotating magnets of one machine across the rotating magnets of the other."

"They will appear to be stationary when absolutely in phase, just as two perforated discs of cardboard do with holes, when they are spun round at equal speeds, one being watched through the other."

"It is quite possible, I think, that some optical synchroniser might be found which would be more satisfactory than either acoustic or electrical synchronisers used with lamps."

The authors humbly venture to suggest that what Dr. Thompson foresaw, before the use of revolving spots was known at all, may be sometime more fully realised than it is now, and that optical methods, which are at present quite in their infancy, and only used as rough guides to the man at the engine, may be the methods of the future.

THE ELECTRIC LIGHTING (CLAUSES) ACT, 1899.

This Act, which has been passed for the purpose of incorporating in one Act certain provisions usually contained in provisional orders made under the Acts relating to electric lighting, comes into operation on October 1st, 1899. It consists almost entirely of a schedule comprising rules and regulations in accordance with which undertakers are to supply electricity in the area named for that purpose in any special order of the Board of Trade, and a short clause of incorporation will have the effect of materially shortening any such order. The provisions of the schedule are to be read and construed subject in all respects to the provisions of the Electric Lighting Acts, 1882 and 1888.

The following abstract, which does not claim to give anything more than a bare outline of a long and complicated schedule, will serve to show the general nature of the rules which must be observed by an electric lighting corporation.

After an interpretation clause which defines the various technical terms used in the schedule, the second section provides that undertakers are to be "the authority, company, or other person named for that purpose in the special order." A reference to the Electric Lighting Act of 1888 shows that the local authority in any given area are not only entitled to be undertakers, but that they may, subject to the provisions of Sec. 2 of that Act, purchase compulsorily the undertaking of any private company or person. This power is in no way curtailed by the new Act.

By Section 5, where the undertakers are not the local authority, provision is made for the deposit of a sum of money to the amount specified in the special order by way of security for the due execution of the works. The sum so deposited is to be repaid in equal moieties as soon as it is certified by an inspector that sums equal in amount have been expended on the works by the undertakers.

The 7th Section makes provision for the outlay of monies received by the undertakers—other than borrowed money or capital—in the following order:—

1. Payment of working and establishment expenses.
2. Payment of interest or dividend on mortgages and stock.
3. In providing any instalments or sinking fund.
4. Payment of expenses of executing the special order not properly chargeable to capital.
5. In providing a reserve fund, if they think fit.

If the surplus in any year exceeds £5 per centum per annum upon the aggregate capital expenditure on the undertaking, the undertakers are to make such rateable reduction in the charge for the supply of energy as in their judgment will reduce the surplus to that maximum rate of profit. This enactment will be appreciated by consumers, but the limitation of profit to 5 per cent. will not afford any very strong inducement to private companies to undertake the supply of electricity.

Where the local authority are undertakers a curious provision in Section 8 prevents them from purchasing ten or more houses which, on the 15th day of December last, before the commencement of the Special Order were occupied by the "labouring class."

By Section 10 it is absolutely forbidden for the undertakers to place any electric line above ground except on their own premises, while connection with earth is prohibited unless with the consent of the Board of Trade and the Postmaster-General.

Sections 11—20 deal with the works which the undertakers may effect, and prescribe the various notices to be served before operations are commenced. By Section 14, if they propose to place any works along any street or public bridge, one month's notice must be given to the local authority and the Postmaster-General, who may approve or object. If any objection is lodged the undertakers may appeal to the Board of Trade. Default in meeting with the requirements of this section is visited with a fine of £10, and a daily penalty of not more than £5.

Where streets are repairable by the County Council, and where the proposed works are likely to interfere with any such street, or any railway or canal, it is provided by Section 15 that notices must be served upon the County Council in the former case and in the latter case upon the body or person for the time being entitled to work the railway or upon the owners of the canal as the case may be. Disputes arising with regard to compensation are to be settled by arbitration.

By Section 16 the person or body liable to repair any street, or entitled to work any railway or tramway which the undertakers are empowered to break up for the purposes of the special order, may, after giving the undertakers notice themselves, perform the undertakers' work, in relation to the breaking up, filling in, and reinstating of roads, &c. Thereupon they shall be entitled to execute the works at the request of the undertakers to whom they may also look for expenses properly incurred.

With regard to alterations of pipes, wires, &c., under streets, these can only be made subject to notice having been given to the owner of the pipes and wires [see Section 17]. This provision applies equally for the protection of the undertakers themselves.

By Section 18, the undertakers are required to give three days' notice to gas companies, water companies, and the local authority of their intention to dig or sink any trench for laying down or constructing any new electric lines. A similar duty is imposed upon these bodies when they are about to take up the road. In each case the interested parties are entitled by their officer to superintend the works. Penalties are imposed for the infringement of this clause.

Section 20 contains stringent provisions with regard to the laying of electric lines in such a manner as to interfere with any existing telegraph or telephone wires.

Sections 21—26, which provide for compulsory works, contain some enactments which are of interest to the consumer. The undertakers are compelled to lay down suitable wires, &c., within two years after the commencement of the provisional order. Twenty-eight days before commencing to lay an electric line in any street, they must serve upon the local authority, and the owners and occupiers of the premises adjoining, a notice of their intention so to do. Default in laying mains within the prescribed period may be punished by fine, or in extreme cases by revocation of the special order. A requisition to lay distributing mains may be made by six or more owners of premises along any one street. This may be refused by the undertakers unless the persons making the requisition, in addition to certain other undertakings, guarantee to take a supply of energy for three years.

Sections 27—30, which deal with supply, provide for a continuous supply of electrical energy. "The maximum power with which any

consumer shall be entitled to be supplied shall be of such amount as he may require to be supplied with not exceeding what may be reasonably anticipated as the maximum consumption in his premises." Penalties to the extent of 40s. may be imposed upon the undertakers in respect of each day upon which the supply fails—except where it was occasioned by *force majeure* or inevitable accident.

Sections 31—34 deal with the price at which the supply is to be furnished. Quantity supplied may be estimated either:—

1. By the actual amount of energy supplied; or
2. By the electrical quantity; or
3. By such other method as may be approved by the Board of Trade.

The prices to be charged are not to exceed those mentioned in the special order, subject to revision by the Board of Trade.

Electric inspectors may be appointed by the Board of Trade. Their duty will be to inspect the undertaker's lines and works, the meters of consumers, and to undertake any other duties required of them by the special order. Their salaries are to be paid by the local authority.

By Section 38 it is provided that notice of any accident by explosion, &c., is to be sent to the Board of Trade by the undertakers.

Sections 39—48 make provision for the inspection and testing of mains, and also the works and supply on the consumer's premises, for which purpose the undertakers are to provide instruments on their own premises. These tests may be made at all reasonable times by the inspectors appointed in accordance with the provisions of this Act.

Sections 49—59 provide that meters are to be used in all cases, unless otherwise agreed between the consumer and the undertaker. Meters are to be supplied by the undertakers, but must be kept in order by the consumer at his own expense. Where meters are let on hire by the undertakers they must, unless the agreement otherwise provides, keep the meter in order. Any differences as to the correctness of the meter are to be settled by the inspector. Where the method of charge is altered, the undertakers must provide new meters to the consumers.

The undertakers may place upon the premises of any consumer a meter to measure the supply, or to check the measurement of the consumer's own meter.

Sections 61 and 62 make provision for the service of the notices required by the Act, indicating the persons upon whom such documents are to be served. In computing the time within which this duty must be performed, certain holidays and fast days are excepted.

Sections 63—68 deal with the revocation of the Special Order under certain circumstances. It will be revoked under the following circumstances: (1) Where undertakers are insolvent. (2) Where the undertaking cannot be carried on with a profit. (3) Where the local authority are undertakers and the works are not executed; (4) by consent.

By Section 69 it is provided that in certain cases where it is proved (*a*) that the undertakers are supplying energy otherwise than by an approved system; (*b*) that any lines are defective; (*c*) that any work of the undertakers injuriously affects any telegraphic line of the Postmaster-General, the Board of Trade may by order specify the matter complained of, and require the undertakers to abate it, under penalties for delay.

By Section 76 all penalties, &c., and other monies recoverable under the Special Order may be recovered summarily in the manner provided by the Summary Jurisdiction Acts.

Section 77 renders the undertakers answerable for all accidents, damages, and injuries happening through the Act or default of them, or of any person in their employment, by reason of or in consequence of any of the undertaker's works, and imposes upon them the duty of indemnifying all authorities, bodies, and persons by whom any street is repairable and all other authorities, companies and bodies, collectively and individually, and their officers and servants, from all damages and costs in respect of those accidents, damages and injuries.

By Section 79 the Postmaster-General is declared to be entitled to all his rights under the Electric Lighting Acts, 1882—1888, and the Telegraph Acts, notwithstanding that those are in addition to the rights conferred upon him by this Act as incorporated in any Special Order.

By Section 81 it is provided that nothing in the Special Order shall exonerate the undertakers from their common law liability for nuisances.

Subject to certain modifications which are set forth in Sections 83 and 84, the Act is made applicable to Scotland and Ireland.

An appendix incorporates the following Sections of certain public Acts with this Act:—

1. Electric Lighting Act, 1882, Section 12.
2. Gasworks Clauses Act, 1847, Sections 6—12, and Sections 18—20.
3. Gasworks Clauses Act, 1871, Sections 38—42, and Sections 45 and 46.

THE COPPER MARKET IN AUGUST.

Messrs. H. R. Merton & Co.'s statistical report for the fortnight ending August 31st shows that the price of standard copper has advanced 10s. per ton, and that the stocks in European ports or afloat thereto have fallen 630 tons since July 31st. The position, therefore, is slightly less favourable to consumers of the metal than at the commencement of the month. The supplies during August totalled 17,965 tons, against 18,595 delivered, and the stocks on August 31st amounted to 32,389 tons.

The supplies during August from North America and from Chili were below the average of the preceding 12 months, while from all other countries the supplies have exceeded the average. The shipments from "other countries" are less than in July, being 4,245 tons, as compared with 6,767 tons in the previous month; but both of these totals are above the average, and promise well for the future yield of these outside countries.

The relative costs of copper and aluminium, when used as electrical conductors, are now expressed by—

$$\frac{8{\cdot}93 \times 8{\cdot}62 \times 59}{2{\cdot}68 \times 14{\cdot}5 \times 100} = \frac{4,541}{3,886} = \frac{116}{100}$$

Aluminium at 29 cents per lb. (the Pittsburg Company's price for aluminium rods) is, therefore, still considerably cheaper than copper.

The following new copper mining companies have been floated during August:—

Mount Lyall Blocks Copper Corporation, Limited, Capital £300,000.

The capital of this company had been privately subscribed, and the prospectus was published merely for public information. The vendors take £275,000 in shares, and the remaining £25,000 is held as working capital. The property covers 70 acres, and adjoins the North Mount Lyall Company's property in Tasmania. A body of ore 40 feet in thickness has been found, and 121 assays of daily samples taken from the ore face have shown over 10 per cent. of copper. The only report on the property appears to be by Mr. R. Schloesser, M.E., acting for the vendors, the Mount Lyall Blocks Mining Company, of Melbourne. The cost of mining and delivering the ore at Queenstown-Tasmania is estimated in this report at 11s. per ton. Gold and silver are expected to be obtained in payable amounts.

The Caledonia Copper Company, Limited, Capital £750,000.

This company has been formed to purchase and develop two groups of copper ore properties in New Caledonia—the island in the Pacific Ocean. The properties cover an area of over 4,000 acres. The two groups are connected with each other and with the coast by a railway nearing completion. The ores are sulphides. The Pilon property has been extensively developed, and bodies of ore, assaying 8 to 20 per cent. copper, have been located. The Ao property has not yet been satisfactorily opened up, but the indications point to the geological formation being similar to that of the Pilon property. The average value of the ore in sight, *after subjection to hand picking and concentration*, is given as 15½ per cent. copper, 8 oz. silver, and 9 grains gold. An annual shipment of 40,000 tons is estimated, and taking copper at £65 per ton, an annual profit of £265,000, or 35 per cent. on the capital, may be expected.

The International Copper Corporation, Limited, are the vendors, and are realising at a profit. £50,000 is to be appropriated for working capital.

The purchase price is fixed at £700,000 in cash or shares.

Taking the above figures, a simple calculation shows that the estimate of a 35 per cent. return on the capital is based on a profit of £43 per ton of copper contained in the ore. This is too high, and we shall be surprised if the 35 per cent. dividend is ever paid or earned. *If* the International Copper Corporation, Limited, are assured of the latter, would it not pay them to stick to the property?—for 35 per cent. dividends are not very common at the present day.

The Mount Chalmers Copper Mines, Limited, Capital £300,000.

This company has been formed for purchase and development of the Mount Chalmers Copper Mines in Queensland. The properties cover 140 acres, and are situated 20 miles from a railway and 16 miles from the coast. Shafts have been driven through the property, the main body of ore has been located, and 1,500 tons of ore have been brought to the surface. 200,000 tons ore is estimated to be in sight, averaging 6 per cent. copper, 4 ozs. silver, and 6 dwts. gold.

Taking an output of 500 tons ore per week, a smelting plant of this capacity should yield a profit of £78,000 per annum with copper at £50 per ton. The mining and smelting charges should not exceed 22s. 6d. per ton.

Mr. D. W. Baxter is the vendor, and is re-selling at a profit for £250,000, £175,000 of which is to be paid in ordinary shares and the balance in cash or shares.

In conclusion, we may draw attention to a note in the Foreign Intelligence columns of the *Times* of August 2nd, to the effect that a Russian mining association has obtained a 70 years' lease of a territory which includes nearly all the north of Persia, and is *believed* to contain the richest copper mines in the world.

The Amalgamated Copper Company, of New Jersey, will certainly have to increase its capital to an alarming extent, if any control of all these new producing mines is to be established or maintained.

AUTOCAR TRIALS AT LIVERPOOL.

The recent autocar tests at Liverpool form the subject of some pretty scathing remarks in a contemporary by a writer and an engineer who signs himself "Traction Engine." The gist of these remarks is that the small loads asked for in autocar work are a mistake; that the autocar people are beginning to learn what is now ancient history with traction engine makers, and that road work with steam motors will approach

traction engine practice; and finally, to sum up, we may almost say that the problem of road traction would have been solved long ago if it had not been for the very severe restrictions imposed upon the use of traction engines.

The writer goes into considerable detail in his letter in respect of the question of flat tyres and other details, and concludes that progress is being made, and that in a few years' time it may be possible to purchase a really serviceable motor van at half the prices asked for the things now being made. He compares £500 worth of motor van with £500 worth of traction engine greatly to the advantage of the latter.

We think, however, that while there must and will be many errors in the early days of the autocar and similar vehicles, there will be some sound practical outcome in the shape of something different from a traction engine. As to the steam traction engine as now built nothing but admiration can be recorded. It is really a fine sight to see a traction engine sunk up to its axles in soft clay on an irregular surface; to see it fed under its wheels with chunks of timber and watch it climb out of the slough by its own energy. There are few specimens of mechanical engineering that surpass a good strong traction engine. The adaptation of means to an end and the way in which an engine accommodates itself to any sort of surface and climbs banks and obstructions are really marvellous. Roads were made for vehicles to run upon. We fail to see that gas and water mains should be allowed to limit the user of the road surface, because gas companies are so busy diluting their product with hydrogen and carbonic oxide—we apologise, we should say water-gas—that they have no time to place their pipes properly. The traction engine makers have met their problem by slow speeds and heavy loads, and if freed from unreasonable restrictions, an immense field would be laid open for their use. But this does not dispose of the fact that there is a need for lighter vehicles also. We are inclined to doubt the value of the small-tube boiler for the work of the autocar. There are many curious feed waters likely to be put into the tank of a road engine. This cannot be guarded against. How will small bent tubes act with such waters, often excessively sedimentary? "Traction Engine" very properly animadverts on the placing of working parts or undergear within 5 inches of the ground. This, of course, cannot be admitted; it cannot endure, and with many other crudities must be eliminated from autocar work.

Such letters will do good. Criticism of a fair nature will not kill. Autocarists have much to learn, and if in earnest will welcome technical criticism.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

In view of the meeting of the British Association for the Advancement of Science now proceeding, the reports of the convention of the American Association, held at Columbus from August 21st to 26th, possess a special interest. During the meeting there were 273 papers read, a large number being on electrical subjects. The president was Dr. Edward Orton. We are indebted to the *Electrical World and Engineer* for the following abstract of his inaugural address, as well as for the papers which are also briefly summarised below:—

Dr. Orton reviewed the progress of science and its effect upon civilisation since the human race "first found itself." He looked back so comprehensively and with such a clear mental vision from the closing year of the present century, and compared the 19th century with all past time so ably that much of the final success of the meeting is attributable to his masterly address. White haired and trembling with age, after 50 years of devotion to the progress of human knowledge, yet preserving all those graces that fit him to preside over a deliberative body, the effect of his presence on that occasion was impressive. His language was so simple and well chosen that it would be hard to find a twelve-year-old boy who would not have listened to and understood perfectly what he had to say. Dr. Orton said that the next century seemed destined to show the rounding out of medicine into an exact science; a better knowledge and use of the laws of energy; a nearly perfect understanding of the phenomena of electricity and magnetism; and some comprehension of the mystery of life itself. What is needed to-day in science are builders as well as analysts, for the most useful truths are the great ones, and the new ones destined to be discovered will be arrived at by putting together some of the dry technical facts of which science is full to-day. He said in part:—

"Our contributions to science are often fragmentary and devoid of special interest to the outside world. It is possible that we could make ourselves more interesting to the general public if we occasionally foreswore our reserve and spent a portion of our time in re-stating established truths. We do not always know the real significance of what we have in hand. A fact or an observation that we may put on record here may have in reality a different significance than the one we are disposed to give it, and consequently may have far more importance than we recognise. But every fact has a place in the great temple of knowledge, and the wise master builders, some of whom appear in every generation, will find them and use them all, and then only will their true value come to light. The field which is the world was never so white to the harvest as it is now, but it is still early moving on the dial of science."

After President Orton's address the association divided into sections as scheduled, in order to facilitate special work in each of the various departments of science. There were nine vice-presidential addresses, each before its respective section.

Prof. C. M. Woodward, of Columbia University, was elected president, to succeed Dr. Orton at the 1900 meeting, which is to be held in New York City.

An Apparatus for the Demonstration of the varying Currents in the Different Conductors of a Rotary Converter.—By Prof. F. C. Caldwell, Ohio State University.

This apparatus consists of (*a*) a disc of paper board, having a narrow slit cut along a radius, and occupying nearly the whole of the latter, on the edge of which slit is a scale of plus and minus amperes, with the zero at the middle; (*b*) a paper disc, placed under disc (*a*) and marked with a datum circle under the zero of current, and a sine curve drawn with radial ordinates, its maximum being equal to the maximum alternating current supplied to the converter. Also two lines parallel to the sine curve, and radially distant therefrom by the amount of the direct current; (*c*) a back of paper board, upon which are represented two pole-pieces and two brushes, and upon a pivot in the centre of which disc (*a*) and (*b*) turn. (*d*) Strips representing collector ring connection being so placed, and the disc (*b*) being so attached to the back, that the maximum of the sine curve will come under the slit when the section of the armature disc (*a*), including the slit, is under the centre of the pole-piece, by revolving disc (*a*) the ordinate cut off by the slit from one or the other of the lines parallel to the sine curve will give instantaneous current in the conductor represented by the slit. The different current curves in the conductors, differently situated with reference to the collector connections, may be studied by changing the points of attachment of the latter relatively to the slit. Other phenomena may also be studied.

A New Form of Electrical Condenser having a Capacity Capable of Continuous Adjustment.—By Lyman J. Briggs, Physicist, U.S. Department of Agriculture.

This condenser consists of a stack of spring brass and mica sheets, arranged in the usual manner. The spring brass plates are given a curved form, so as to present an open structure when the condenser is assembled. The capacity of the condenser can consequently be continuously varied by compressing the system of plates. The condenser can be used either in air or oil.

Current and Voltage Curves in Magnetically Blown Arc and in Aluminium Electrolytic Cell.—By Prof. R. A. Fessenden, Western University of Pennsylvania.

Shows that placing an alternating current arc in a strong magnetic field makes the current wave flat-topped and increases the efficiency. Curves of voltage and current taken between different points in an aluminium cell shows that polarisation, not pure resistance effects, are due to the formation of $Al_2 O_3$, but that change of phase absolutely takes place as film acts as dielectric of condenser. Efficiency low.

Electrical Anæsthesia.—By Dr. E. W. Scripture, Yale.

A method is described of producing anæsthesia—or rather analgesia—by direct application of an electric current and without either internal or local application of drugs, and based on the following priciples:—

An alternating current—preferably a sinusoid—with equal positive and negative phases is made to traverse the nerve. At a proper frequency—about 5,000 complete periods in a second—it can be made to cut off all sensory communication by this nerve. Needles can be run into the part of the body supplied by the nerve without any pain being felt.

Groups of nerves, *e.g.*, the brachial plexus, can be cut off from communication in a similar manner. Experiments are now being made in the effort to get at the root of the spinal nerves, and thus it will cut off communication with the various parts of the body. Experiments have been tried in sending the current from the Casserian ganglion through the superior maxillary nerve with a view to cutting the teeth from communication, but the contraction of the facial muscles have proved as yet too disturbing.

The experiments have made evident the fact that with increasing frequency of alternation the muscular contractions decrease; it is proposed to raise the frequency still higher to avoid muscular contractions while retaining the analgesic effect, a machine for this purpose being now under construction.

Concerning the Fall of Potential at the Anode in a Geisler Tube.—By Prof. Clarence A. Skinner, University of Nebraska.

Observations were made with a Geisler tube, cylindrical in form (length, 20 cm., diameter, 4 cm.), provided with disc electrodes (diameter about 2 cm.). The results given below were obtained in nitrogen gas (pressure, 3 to 6 mm.), through which a constant electric current from a storage battery of 600 cells was passed.

The fall of potential at the anode was measured by a quadrant electrometer as the difference of potential between the anode and a movable platinum wire which could be approached to contact with the anode. So far as it can be proven by this method, the fall of potential at the anode is of the nature of a sudden drop between electricity and gas. In the immediate neighbourhood of the anode

the gas is a perfect conductor, the potential gradient is zero. The space of perfect conduction may extend about 2 mm. from the anode, but its extent decreases rapidly with increasing gas pressure. Outside the potential gradient the potential gradient rises more or less rapidly to a constant value throughout the unstriated positive column, or luminosity. The fall of potential at the anode is: (*a*) independent of the current density, be the gas pure or impure, the anode clean or tarnished; (*b*) increases slowly with increasing gas pressure; (*c*) increases rapidly as the anode becomes tarnished; (*d*) is sensibly influenced by impurities in the gas; (*e*) for all metals with polished surface tested, lies between 18 and 35 volts at 1 mm. gas pressure; whereby of the metals the one which has the smaller fall of potential at cathode shows greater at anode. Further, it was found that the greater the fall of potential at the anode, the greater the distance from the anode in which the gas was rendered a perfect conductor, and also the slower the potential gradient outside this space rose to its constant value for the positive column.

On the Nature of Electricity and Magnetism, and a Determination of the Density and Elasticity of the Ether.—By Prof. A Fessenden, Western University of Pennsylvania.

Fourier's idea of dimensions, as shown by his definitions, was explained, and it was pointed out how these have been departed from by later authors in suppressing dimensions, thus making the formulæ merely a question of units. It was shown how Fourier's ideas may be applied to the problem of the solution of the nature of electricity. All electrical phenomena, whose laws can be formulated in relation to mechanical quantities, are contained in the following three equations:—

$$1 - q/b :: k/u$$
$$2 - ku :: T/L$$
$$3 - qb :: ML/T$$
$$4 - qu :: Z$$

Having but three equations and four unknown quantities (q : : quantity of electricity, b : : quantity of magnetism, k : : specific inductive capacity, and u : : magnetic permeability), we cannot directly solve. Putting, however, q equal to an unknown term, z, and q z, we may obtain all possible theories of electricity, including those already proposed by Lodge, Kelvin, Heaviside and others. For example, if z be put equal to L T, then k becomes a density, u the compliancy, &c., as given in one of Heaviside's theories. For the solution we must get a fourth equation.

A sketch of work extending over a number of years in search for this fourth equation and its discovery found in the relation between velocity of sound and electric conductivity; other relations were discovered, but none giving a new equation.

Williamson's proof that either k or u must be a density. This proof incomplete. Proof made complete, and same results obtained by two other methods. How to decide which is the density.

We have relations between q and b, and k and u; we must therefore look for relation between q and u, or b and k, *i.e.*, between H and u and v and k. This leads us to the above conclusion through the above three equations.

1. "Either k varies inversely with v, or u with H."
2. "The coefficient which varies inversely with the corresponding intensity is a compliancy."

This gives a touchstone for detecting which of the two theories is correct. It is then shown that k does not vary inversely with v, but that u does with H. Therefore k is a density and u a compliancy. Part 2 of the paper contains additional proof. Shows that the effects of stress, permanent strain, change of composition and elastic properties all agree with this theory and give the results predicted by it. It is shown that all magnetic properties of iron can be expressed by two coefficients, and it is shown that the hysteresis coefficient is equal to one of these multiplied by a constant.

It is also shown that there is a single relation between the density of substances and their specific inductive capacity, and that we are thus enabled to determine the density of the ether. This is done. It is also shown that the variation of density with temperature and with change of state follows this theory.

Part 3 contains an account of the experiments made to establish the relation between H and u and of the precautions taken to avoid error. Curves are given showing results.

The Dielectric Strength of Oils.—By Prof. Thomas Gray, Rose Polytechnic Institute.

At last meeting of this association the author presented an account of some experiments on the dielectric strength of insulating substances, in which the results for oils were somewhat uncertain, and it had been found difficult to form any very decided opinion as to whether the dielectric strength of a layer of oil is or is not proportional to the thickness of the layer. During the past spring Mr. C. E. Keyes, a member of the graduating class at the Rose Polytechnic Institute, continued the experiments on oil. Mr. Keyes directed his attention largely to the questions of proportionality of strength to thickness and the effect of filtering through drying materials like calcium chloride. The difficulties experienced last year, due to the variations of the dielectric strength under continued electric stress, were again met with. It was found that filtering through chloride of calcium or leaving the oil for a day or two mixed with that substance did not remove the trouble and almost always reduced the strength considerably. By making a large number of measurements in cycles of varying thickness of layer and then averaging the results, considerable evidence was accumulated which went to show that the dielectric strength per centimetre thickness is greater the thinner the layer tested. Oil seems, therefore, to agree with gases and most solids in this respect. The author stated that the subject is not by any means closed, but he gave a few of the average results as an indication of the evidence obtained. The absolute value of the dielectric strength is largely a function of the length of time during which the oil has been subjected to electric stress. A considerable number of oils were tested, and many of the samples gave results of a very erratic character. It seems probable that there is a gradual change in the dielectric properties of these liquids while under stress. Possibly the whole difficulty is due to a species of polarisation which may be most marked close to the place.

In the following table the numbers in the headings are the thickness of the layers tested; the first column contains the name of the oil and the numbers in the body of the table are the dielectric strengths in kilovolts per centimetre:—

Kind of oil.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Vaseline	131	120	109	103	105	95	96	91	...	...
Paraffin, 28 G. ...	91	81	76	71	73	70	69	70	72	...
Paraffin, 26 G. ...	101	89	85	79	79	71	66	64	62	60
*N.W.V.O., 29 G.	81	79	74	72	69	62	63	62	60	...

* Natural West Virginia crude oil from 29-30 gravity.

Polarisation and Internal Resistance of Copper Voltameter.—By Prof. B. E. Woods, University of Nebraska, Lincoln, Neb.

The polarisation of electrolytic cells by means of direct current is usually measured upon an independent circuit after the polarising current is removed. The charge from the one circuit to the other cannot be made instantaneously and the polarisation actually measured is less than the maximum. This has its effect upon the apparent internal resistance, r, which is calculated from the formula, $r = \frac{E-P}{i}$ where E, P and i are the applied electromotive force polarisation and current respectively. Values of r thus obtained decrease erroneously with increasing i. The experiments indicate that this arises from a failure to measure the maximum of P. This is shown by measuring P at different time intervals after the removal of the current. The time intervals vary from ·00006 to ·045 of a second. The results indicate that constant resistance for all current strengths would probable be obtained if the polarisation could be measured in zero time after the removal of the polarising electromotive force. Measurements were made with the condenser and ballistic galvanometer and the circuits were manipulated by a swinging pendulum. The smallest time interval is very near the time required to charge the condenser through the apparent electrolytic resistance. Therefore shorter time intervals, though desirable, can hardly be obtained by the condenser method. However, greater accuracy in the determination of the shortest time interval is possible and desirable. The observations are limited to the copper voltameter with different size plates.

An Absolute Determination of the E.M.F. of a Clark Cell.—By Prof. H. S. Carhart and K. E. Guthe, University of Michigan.

The paper gives an account of the continuation of experiments made with an absolute electro-dynamometer for the determination of electrical units. While last year the electro-chemical equivalent of silver was redetermined, this year by practically the same method the E.M.F. of the Clark standard cell was found. As a result of the measurements, E = 1·4333 volts at 15° C.

The Equipment and Facilities of the Office of U.S. Standard Weights and Measurements for the Verification of Electrical Standards and Measuring Apparatus.—By Dr. Frank A. Wolff, jun.

The paper briefly outlines the steps so far taken by the office of standard weights and measures for the verification of electrical standards and measuring apparatus submitted by institutions, the trade and by individuals. A description is given of the preliminary standards of references adopted, the methods of comparison employed and the accuracy obtainable as shown by comparisons already made.

To fix the value of the preliminary standards of resistance pending the construction of a number of mercury units, frequent comparisons are to be made of the present standards with each other, with mercury copies, the construction of which is to be taken up immediately, and with new coils known to the highest degree of precision in terms of Reichs-Austalt mercury units, and therefore in terms of the B.A. coils.

The unit of electromotive force will similarly be fixed by a construction from time to time of new Clark and cadmium cells from specially purified materials by the frequent intercomparison of the old ones of each type with each other, and by the determination of the ratio from time to time of the Clark and cadmium cells of the office.

The object of the paper is mainly to announce to the public in general this enlargement of the scope of the work and its policy to guarantee the highest present attainable accuracy.

Effect of Magnetisation on the Modulus of Elasticity.—By Prof. J. S. Stevens, University of Maine.

It has already been found (Cornell Lab.) that temperature changes

affect the modulus of electricity. This experiment tested the effect of magnetisation. Steel and wrought-iron bars 60 × 1 × 0·64 cm. were used, and loads of 1 kg. and ½ kg. fastened to the centre. These caused a deflection. When the rods were magnetised by forces ranging from 199 to 126 C.G.S. units, the deflection was decreased, showing that magnetisation increases the modulus.

The change in deflection was increased by an interferometer, one plate of which was fastened to the bar, and the motion read in wave lengths of light. Temperature changes were guarded against —(1) by a stream of water flowing between coil and rod; (2) by testing with a sensitive thermometer; (3) by noticing that the change in deflection was always sudden; (4) by discovering no change in a copper rod.

The measurements were not considered sufficiently exact to enable it to be stated that there is a regular relation between magnetic force and the modulus increased with the magnetising force.

THE STRESSES IN STEAM ENGINES, WITH SPECIAL REFERENCE TO ELECTRIC TRACTION.

II.

In commenting upon this subject it was the writer's intention to say something on circuit breakers, never having seen a traction plant without some form of circuit breaker; it was something of a surprise to read Mr. Taylor's criticism, which was based apparently on the impression that the first article had been intended to apply to a plant without a circuit breaker. It was, however, simply written on the assumption that circuit breakers, as usual, did exist, and that they would act as desired. It cannot, however, be denied that in the best of plant, apparatus may sometimes fail, and it is a matter on which very wide ranges of opinion may exist, as to how far a plant must be saddled in perpetuity with a charge designed to meet a case that may never arise. American bridges, for example, are sometimes designed to resist wind stresses of 56 lbs. per square foot, when not loaded. When loaded, however, a wind stress of 30 lbs. only is provided for, the reasoning being that anything over 30 lbs. will overturn the train and wreck the bridge, and, in brief, it is as well to be hung for stealing a sheep as a lamb. It is a little curious that Americans, who have so long been reviling English wastefulness of material—they call it ignorant clumsiness—should now be under criticism on the same score. In most instances our English clumsiness has proved correct practice, and American clumsiness seems to be genuinely the other thing. In providing excessive shaft strengths to meet a possible failure of circuit breakers, an engine is charged in perpetuity with a constantly acting brake. The question is thus: Will it pay? It seems to be an axiom of good design that such enormous stresses should be provided against by arranging the parts so that they cannot receive excessive stresses, not that they should be clumsily strong to withstand them. In rolling mill work excessive stresses are so common, and practically outside of design to provide for, that breaking pieces are introduced whose sole duty is to break when the stress exceeds a certain figure. It would have been better had the Glasgow engines been designed with a breaking piece between the fly-wheel and the generator than that the whole structure should have been excessive. Breaking pieces can be cheaply made and can be kept in stock and rapidly changed. But in traction work it is not impossible to design in such a way that the stress due to a short circuit shall not come upon the shaft. To show this up clearly a little steam engine history may not be out of place. Sixty years ago a very usual factory engine was a single beam engine. A large fly-wheel was fixed on the shaft and revolved close against the engine house wall. On the other side of the wall was placed a large spur wheel also on the engine shaft. All interchange of energy between the fly-wheel and the spur-wheel had to pass down the fly-wheel arms, through the keys, along the shaft, through the keys of the spur-wheel, along the arms of this, and so to the teeth.

Had the exchange of energy been very great many shafts would have twisted off. Probably a good number of old cast-iron shafts did break. But in due time all this stress was abolished by one of two systems of construction. One system was that of Fairbairn, who fastened the toothed rim outside the rim of the fly-wheel; hence arose the spur fly-wheel. The other system consisted of casting a bracket on each fly-wheel arm a short distance inside the rim and fixing the toothed rim segments to these brackets. Obviously, in neither case did any transfer of energy take place through the shaft. This served merely to transmit the maximum steam pressure stress to the fly-wheel, and all further stress was dealt with between the fly rim and its load or work. In the Glasgow engines the fly-wheel is properly placed, so far as it protects the engine from sudden and excessive loads, but it is placed on the opposite end of a piece of shaft from that occupied by the generator, and this bit of possibly heavily stressed shaft ought to be the breaking piece, and should be designed as such. Now it is bad design to have what is really looked on as a breaking piece and yet not to design it as such. The suggestion is obvious; reform it altogether by designing a fly-wheel generator. These are made, and have been made. Would not the present be a very suitable time for the question to be discussed? American practice seems to favour a type of generator for traction work which does not possess in itself any qualities of the fly-wheel. The large engines intended at one time to have been employed at Deptford in electric light work would have furnished a good illustration of the suitableness of fly-wheel generators. The present writer has dealt solely with the mechanical and structural side of the question. The fly-wheel generator would at once protect the engines as now a fly-wheel protects them from undue stress, and it would abolish the necessity of abnormal shaft diameter to meet the possible stress arising from a dead short, and not dealt with by circuit breaker, this being assumed to fail. The question is one which deserves attention, for by continuing the use of a generator only connected to the fly-wheel through the medium of a common shaft, there is introduced an element of uncertainty against which the only safeguard is the circuit breaker.

From the tone of Mr. Taylor's criticism there appears, in his mind at least, a certain doubt of the circuit breaker. Given a perfectly satisfactory fly-wheel generator, it would then appear that the enormous stresses of which we have heard so much have been driven into the connection between the fly-wheel and the generator, and any result of a short will be a burn-out. If, on the whole, the circuit breaker is a reliable article, it will prove cheaper to risk a burn-out than a break. But if the circuit breaker is to fail frequently, it might easily prove cheaper to revert to present construction and put in the designed breaking piece.

The reliable character of circuit breakers is certainly an assumption underlying much American engine practice, for the only breaking pieces are the crankshafts and crank pin, through which the stress, described by Mr. Taylor as probably 1,000 per cent. of ordinary stress, is compelled to pass. Does not this prove the generally reliable quality of circuit breakers?

Finally, where a generator must be of such a type as to demand a separate fly-wheel, it would appear to be good practice to allow the necessary shaft strength, by placing both the wheel and the generator on a shaft of sufficient strength, but avoiding the use of such excessive diameters at the bearings. In a pair of engines with generator between this is readily arranged. That this has not been done is evidence that the location of stresses has been little studied.

THE B.A. PRESIDENTIAL ADDRESS.

The address of Prof. Sir Michael Foster, K.C.B., Sec. R.S., the new president of the British Association for the Advancement of Science, delivered at Dover on Wednesday evening, contains very little that is of direct interest to electrical men. We extract the following, re electricity:—

"If there be one word of science which is writ large on the life of the present time, it is the word 'electricity'; it is, I take it, writ larger than any other word. The knowledge which it denotes has carried its practical results far and wide into our daily life, while the theoretical conceptions which it signifies pierce deep into the nature of things. We are to-day proud, and justly proud, both of the material triumphs and of the intelligent gains which it has brought us, and we are full of even larger hopes of it in the future.

"At what time did this bright child of the nineteenth century have its birth?

"He who listened to the small group of philosophers of Dover, who in 1799 might have discoursed of natural knowledge, would perhaps have heard much of electric machines, of electric sparks, of the electric fluid, and even of positive and negative electricity; for frictional electricity had long been known and even carefully studied. Probably one or more of the group, dwelling on the observations which Galvani, an Italian, had made known some 20 years before, developed views on the connection of electricity with the phenomena of living bodies. Possibly one of them was exciting the rest by telling how he had just heard that a professor at Pavia, one Volta, had discovered that electricity could be produced not only by rubbing together particular bodies, but by the simple contact of two metals, and had thereby explained Galvani's remarkable results. For, indeed, as we shall hear from Prof. Fleming, it was in that very year, 1799, that electricity as we now know it took its birth. It was then that Volta brought to light the apparently simple truths out of which so much has sprung. The world, it is true, had to wait for yet some 20 years before both the practical and the theoretic worth of Volta's discovery became truly pregnant, under the fertilising influence of another discovery. The loadstone and magnetic virtues had, like the electrifying power of rubbed amber, long been an old story. But, save for the compass, not much had come from it. And even Volta's discovery might have long remained relatively barren had it been left to itself. When, however, in 1819, Oersted made known his remarkable observations on the relations of electricity to magnetism, he made the contact needed for the flow of a new current of ideas. And it is perhaps not too much to say that those ideas, developing during the years of the rest of the century with an ever-accelerating swiftness, have wholly changed man's material relations to the circumstances of life, and at the same time carried him far in his knowledge of the nature of things."

On Thursday morning the Association settled down to the sectional addresses and discussions. Sections A and G are those in which electrical papers are generally read. The names of presidents, &c., are as follows:—

A.—Mathematical and Physical Science.

President.—Prof. J. H. Poynting, D.Sc., F.R.S.

Vice-Presidents.—Prof. W. E. Ayrton, F.R.S.; Prof. A. R. Forsyth, M.A., F.R.S.; Prof. J. J. Thomson, M.A., F.R.S.

Secretaries.—J. L. Howard, D.Sc.; C. H. Lees, D.Sc.; Prof. W. Watson, B.Sc. (Recorder); E. T. Whittaker, M.A.

G.—Mechanical Science.

President.—Sir W. H. White, K.C.B., F.R.S., Pres.Inst.M.E.

Vice-Presidents.—Sir Benjamin Baker, K.C.M.G., F.R.S.; Sir John Wolfe-Barry, K.C.B., F.R.S., M.Inst.C.E.; Sir W. H. Preece, K.C.B., F.R.S., Pres.Inst.C.E.; E. Rigg, M.A.

Secretaries.—Prof. T. Hudson Beare, F.R.S.E. (Recorder); W. A. Price, M.A.; H. E. Stilgoe, Assoc.M.Inst.C.E.

ELECTRIC RAILWAYS.

A special number of *Cassier's Magazine*, wholly devoted to electric railways, has appeared, and is a creditable production, though it may be doubted whether such a number is not rather out of the way of the true magazine. With nearly a score of writers on the same subject in its many details, it is certain there is a considerable repetition, and some want of variety. Probably the most interesting article at this juncture is that by Mr. F. S. Pearson on the "Conduit System." Someone has described New York as a village compared with London. Very probably New York is this in a certain sense—the sense of gas and water-pipe interference—but New York is big enough and bad enough to be able to produce some shockingly bad photographs illustrative of the conduit system—bad, we mean, for the system, for the pictures show a terrific amount of work involved in laying down a conduit system. And if so much in New York, what may not be expected in London? Cross-sections of New York streets show the work to be very heavy, and we much fear that if London is to wait for the conduit system, so easily laid down on the professional blackboard of experts, we shall never see a decent system in London at all. The author of the paper does not attempt to disguise the expense of the conduit system.

Mr. Benjamin Taylor contributes an article on "Municipal Tramways," which is of special interest. He shows that where municipal tramways have been a success, it has been in spite of, rather than because of, municipalisation.

Mr. Abbott, who writes on electrolysis, points out that very little is now heard of this evil, even in America, and if this be so there can be very little prospect of trouble with our B.O.T. rules as to "drop."

Mr. Lloyds writes hopefully on batteries, for long hardly used in America, but now often put in with very large systems. Usually 250 cells of as much as a ton each are installed. They are wood, lead-lined, and in an optimistic vein the battery is prophesied to take care of all load above average. If this desirable consummation could be attained, what a difference would come over traction work! Plain factory engines would run under steady load so many hours a day. The Metropolitan Company of New York has two battery plants of 540 cells each. These cells measure 4 feet × 21 inches × 24 inches, and are placed in two sections of 270 cells each, operated in parallel. The capacity is 8,000 ampere-hours with a one-hour rate of 4,000 amperes. The battery acts as an equaliser, levelling up or down all fluctuations. A third similar battery is being installed.

The Southside line in Chicago formerly showed a maximum load of 7,500 amperes, and a sudden fluctuation of 5,300 amperes. With batteries the maximum load is 5,700 amperes, and the variation only 2,000 amperes.

We need now to see another article on battery maintenance.

A most interesting article is that of Thorburn Reid on "Early Traction History." The year 1835 is the oldest recorded date of electric traction, when one Davenport, of Brandon, Vermont, drove his motors by primary batteries.

Naturally, the whole of the articles have a strong trans-Atlantic bias, and in the midst of so very much laudation of quantity, it is not difficult to pick out facts that point to a good deal of not particularly first-class quality; not but that perhaps a good deal of cheap American construction has enabled lines to be built where otherwise they could not have been. Here we have delayed so much, that we have lost more than would have built cheap lines, and reconstructed them. Perhaps the worst grumbler at the ways of this side is Mr. R. W. Blackwell; but why he should grumble is not very clear. He has secured his share of the work going, and we believe that competition has so far left him quite a decent profit on his prices. We know whereof we speak.

Finally, there is another recurrence of the inevitable City and South London Railway so oft described, but we do not see why the power house should have been illustrated, unless to show, for the benefit of Americans, that it is driven by ordinary non-weighted engines, for there are glaring faults visible in the picture; for example, dynamos with their pulleys far below the engine pulley, and this gross fault counteracted by another as bad, namely, a jockey pulley. When will engineers learn never to run a belt down hill if it can possibly be avoided?

The magazine is further embellished with the worst collection of portraits of the 18 contributors it has ever been our lot to see. We can only trust that they are peaceful men and will not visit the sin upon the editor, who was evidently so worried as to allow one block to be placed upside down.

We cannot think that on the whole the electric railway number has been a success. The subject is not one that appeals to the public as does a naval subject. A singular misprint occurs in Mr. Brill's article on cars. He speaks of the Blackpool Tunnel in London having been once worked by ropes prior to 1873, evidently meaning the old Thames Tunnel.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

17,372. "Improvements in collectors for electric tramways on the overhead conductor system." J. Kalte, H. D. Becker, M. Sees, M. Ely and P. Robinson. Dated August 28th.

17,379. "Improvements in electric arc lamps." O. B. Hellstrom. Dated August 28th. (Complete.)

17,410. "Improvements in electric accumulators." R. Haddan. (R. Goldstein, Germany.) Dated August 28th.

17,411. "Improvements in negative electrodes for electric accumulators." R. Haddan. (R. Goldstein, Germany.) Dated August 28th.

17,417. "Improvements in and connected with electric fuses." G. C. Maas. Dated August 28th.

17,441. "Electroplating apparatus." L. Pothoff. Dated August 28th.

17,445. "Improvements in electric cables." G. E. Heyl-Dia. Dated August 29th.

17,454. "Improvements in and relating to supports for overhead electric conductors." A. Anderson and J. M. Andersen. Dated August 29th. (Complete.)

17,472. "Improvements in continuous electric ringing bells." C. R. Jeary. Dated August 29th.

17,474. "Improvements in electric massage apparatus." T. Berndt. Dated August 29th. (Complete.)

17,477. "Improvements in mouldings for electric wires and other purposes." M. Chase, De F. W. Chase, G. Code and E. Planta. Dated August 29th. (Complete.)

17,486. "Improvements in or relating to electric indicators." H. L. Howard and L. H. Cline. Dated August 29th.

17,504. "Improvements in means and apparatus for recording deflections of pointers, magnetic needles, coils, and the like, and the fluctuations of electric current, and for utilising such deflections or fluctuations to actuate or control various other mechanisms or apparatus." E. A. Goddin. Dated August 29th.

17,507. "Improvements in electric lamps with illuminating bodies made of second-class conductors." V. I. Feeny. (Allgemeine Electricitäts Gesellschaft, Germany.) Dated August 29th. (Complete.)

17,510. "Improvements in electricity meters." W. C. Johnson and T. J. Murday. Dated August 29th. (Complete.)

17,512. "Electrical induction apparatus for igniting combustibles, gaseous charges in gas or oil motors, and the like." J. Harden. Dated August 29th.

17,547. "Improvements in or relating to overhead systems for electric transmission of energy." P. J. Tyrrell and J. Tyrrell. Dated August 30th.

17,553. "Improvements in electric dynamos for continuous currents with unipolar induction." O. A. Zander and B. Ingestrom. Dated August 30th. (Date applied for under Patents, &c., Act, 1883, Sec. 103 February 11th, 1899, being date of application in Sweden.) (Complete.)

17,593. "Improvements in transmission dynamometers or torque indicators." A. M. Morgan. Dated August 31st.

17,707. "Improvements in and relating to electric incandescence lamps." V. I. Feeny. (Allgemeine Elektricitäts Gesellschaft, Germany.) Dated September 1st. (Complete.)

17,715. "Improvements in appliances for cutting off the current from electric elevator motors, and for arresting the fall of the car." J. H. Johnston and W. R. Weeks. Dated September 1st. (Complete.)

17,719. "Improvements in or connected with variable rate electric meters." J. G. Lorrain. (H. A. Macdonald, France.) Dated September 1st.

17,722. "Improvements in telegraphic apparatus." A. C. Crehore and G. O. Squier. Dated September 1st.

17,733. "Improvements in connection with electric lamp and like apparatus for signalling, advertising, and similar purposes." C. E. Kelway. Dated September 2nd. (Complete.)

17,763. "Improvements in electric switches and regulating appliances." J. D. F. Andrews. Dated September 2nd.

17,772. "Improvements in systems of, and apparatus for, electrically transmitting and receiving signals, partly applicable to other purposes." P. M. Jerrard. Dated September 2nd.

17,774. "Improvements in ammeters." W. C. Johnston and T. J. Murday. Dated September 2nd. (Complete.)

17,786. Improvements in electric telegraph apparatus." S. G. Brown. Dated September 2nd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

2,804. "An electric time switch." W. P. Thompson. (The Self-Winding Clock Company.) Dated February 1st, 1898. Relates to improvements in electric clocks and time switches. Consists in a combination in a system of electrical distribution of a circuit forming a part of the system with a switch controlling such circuit, an electrically energized clock, and electric connections for energizing it, a separate electrically energized secondary device acting under the control of the clock to open and close the switch in indefinite repetition and electric connections for energizing said secondary device. 12 claims.

4,317. "A trolley connection for canal boats." F. J. Skewring. Dated February 21st, 1898. Consists of providing the canal boat with a rigid trolley pole reversibly and permanently attached to the boat, a gravity balanced trolley consisting of two trolley wheels journaled in a frame having two depending arms united by a counter-balance, a rod connected to the arms, and a sliding ring mounted on the rod, to which and to the arm of the trolley pole is attached a wire. 3 claims.

4,903. "Improvements in primary batteries." J. E. Fuller. Dated February 28th, 1898. Relates to apparatus for generating electricity. Consists in churning the solution while in use as to keep it from polarizing. 16 claims.

5,008. "Improvements in and relating to the carbon feeding mechanism of electric arc lamps." C. Wood. Dated March 1st, 1898. Consists in mounting above the electro-magnets two jointed arms or levers, one having preferably two arms of the first order, and the other one arm of the third order. These are jointed one above the other on a common bracket, and are only connected through the brake band which passes round the brake weeel, and is connected to the ends of the levers. The levers are so mounted that the end of the set screw carried by the one in their movement travels up and down upon the inclined part or projection through the diffferent ratios of the particular throws of their arms. 8 claims.

5,550. "Improvements in and connected with dynamo-electric machinery." M. T. Pickstone, R. S. Portheim, and A. C. Peebles. Dated March 7th, 1898. Relates to a new self-oiling bearing, a new form of commutator, a new form of brush-holder, and a new form of coil former insulation. The bearing consists of a metal covering attached to which are two bosses. The commutator consists in attaching copper connecting pieces to the inside of the commutator sections, insulating them and clamping them together by metal bush rings. The brush-holder consists of a metal casting, the upper portion of which is machined out to form a slide and to the bottom portion of which is fixed a circular disc which is rigidly attached to a rocker spindle. A circular metal sleeve provided with two projections revolves on the disc and one of these projections press against a similar projection fixed on the brush carrier casting. The other projection on the sleeve contains a compression screw which presses against a suitable spring which is in abutment with the fixed circular disc. The coil former consists of a metal coil former adapted for field-magnet winding and covered with any suitable insulation. 4 claims.

6,147. "Improvements in the electrolytic treatment of ores and slimes for the recovery of precious metals therefrom and apparatus therefor." H. Riecken. Dated March 12th, 1898. Relates to the electrolytic treatment of ores and slimes for the recovery of metals, chiefly gold. Consists of an open vat made of wood and lined at the sides and bottom with sheet copper which is silver plated. The sides are inclined. At the bottom is a trough for the collection of mercury and at the top a perforated pipe for distributing the mercury over the sides. The gold forms on the copper sides over which the mercury flows. The anodes are of carbon fixed to a shaft which traverses the vat, and which is rotated or oscillated by any suitable means. It is connected to the positive pole of a dynamo, the lining of the vat being the negative pole. 6 claims.

6,704. "Improvements in switchboards for the control of high voltage electric circuits and apparatus." H. F. Parshall. Dated March 19th, 1898. Relates to improvements in switchboards. Consists in using the switchboard as an insulating partition between the switch contacts. 3 claims.

9,692. "Improvements in resistance apparatus for regulating electromotors." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktien-Gesellschaft, Germany.) Dated April 27th, 1898. Relates to the starting of shunt electromotors. Consists in employing in place of two sets of resistances only a single set, which is used consecutively for starting the motor and for subsequently weakening the magnetic field. The whole of this set of resistances is employed on one and only a part on the other motor circuit. 2 claims.

9,778. "Improvements in plates for electric accumulators." M. Bornstein. Dated April 28th, 1898. The plate is provided interiorily with a gas chamber, so that gas can be passed in which is capable of renewing the active material. It is specially intended for vehicles. 1 claim.

9,881. "Improvements in means and devices for electrically lighting coin-freed apparatus for displaying pictures." A. W. Witt and M. W. Strikeman. Dated April 29th, 1898. Relates to coin-freed apparatus. The light is given by an electric incandescent lamp in connection with a battery in the apparatus, and is switched on when a handle, which also operates the transparencies, is pushed in and off when allowed to spring out. 2 claims.

10,333. "Improvements relating to electric signalling and similar apparatus." L. S. Crandall. Dated May 5th, 1898. Relates to electric signalling and refers to Specification 13,686, 1895. A monogrammic grouping of lamps is under the control of lock keys. Before the signal proper is lighted, a sight check can be seen. 6 claims.

10,615. "Improvements in automatic apparatus for receiving the charges for telephone conversations and telegrams." L. M. Ericsson and S. Ritter. Dated May 9th, 1898. The coin in the coin-controlled apparatus in falling strikes a gong. The sound is transmitted by the telephone to the operator who does not make the required connection till this is heard. If the connection cannot be made the coin is automatically returned. 3 claims.

10,647. "Improvements in electric incandescent lamps." W. J. Phelps. Dated May 10th, 1898. Consists in a novel construction of the lamp base, whereby a multi-filament lamp may be used interchangeably with ordinary lamps, and in the advantageous use of one or more filaments as relatively dark resistance to modify the current for one or more other filaments within the vacuum. 5 claims.

10,650. "Improvements in and relating to electric arc lamps." F. A. Gilbert and E. O. Lundin. Dated May 10th, 1898. The armature of the solenoid on a tube surrounding the upper carbon. The upper end of this having a piston to enter a centrally supported dash pot at the top of the lamp. The clutch is mounted at the other end of the tube. When the upper carbon is burnt out it drops on to the lower, thus preventing damage to the lamp. 18 claims.

11,360. "Improvements in globe holders for enclosed electric arc lamps." K. Weinert. Dated May 18th, 1898. Consists in detachably securing the globe in position by means of an airtight elastic easily-loosened holder, comprising a ring placed under the upper edge of the globe and furnished on its outer edge with recesses, inclined running surfaces and projections. 2 claims.

12,866. "Improvements in electrical circuit controllers." H. H. Lake. (N. Tesla, United States.) Dated June 8th, 1898. Relates to a circuit controller comprising in combination a receptacle containing a conducting fluid, means for rapidly rotating the receptacle or the fluid therein, and a terminal or terminals supported within the receptacle and adapted to make and break electrical connection with the fluid. 52 claims.

13,011. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (H. C. Spinney, United States.) Dated June 10th, 1898. Relates to lamp clutches, and particularly those in which the clutch works directly on the pencil. Consists in an arangement by means of which the weighted follower may be removed to insert the carbons and then be replaced. 12 claims.

13,707. "Improved electro-acoustic telegraph with Morse transmitter." N. Fiechtenmacher. Dated June 20th, 1898. Consists in a manipulator in conjunction with a Morse transmitter in which the anvil contacts, against which the contact screws of the lever of the manipulator strike, are supported by springs for the purpose of minimising the noise. 7 claims.

13,781. "Improvements in automatic electric block signal systems for railways." L. C. Werner. Dated June 21st, 1898. Consists of the combination of a track having a sectional conductor forming insulated blocks, with a vehicle movable along the track, a primary electrical register controlled by a block circuit, and a separately operative secondary electrical register controlled conjointly by the primary register and a block circuit. 7 claims.

14,959. "Switch and contact apparatus for the cars of electrical railways and tramways." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated July 7th, 1898. Relates to the Elektrotechnische Anzeiger, No. 28. Consists in an arangement by means of which the attendant is obliged on leaving the part of the line with the overhead conductor to disconnect the current collecting appliance from the car circuit in which current under pressure exists. 2 claims.

15,028. "Improvements in the manufacture of electrodes for secondary batteries." H. J. Haddan. (C. Francke, Germany.) Dated July 8th, 1898. A flat grating of lead, without a core, is pressed together mechanically so that the bars formiug the grating lie tightly together, leaving small intervals, and thus a plate body expansible in the direction of pressure is produced. 3 claims.

15,246. "Improvements in automatic break apparatus for electric currents." T. B. Kinraide. Dated July 12th, 1898. Consists in making the standard perfectly rigid, and apparatus for keeping the hammer in accurate alignment with the core end and anvil. The contacting surfaces are revolved so that the sparking may wear them evenly. 13 claims.

15,347. "Improvements in electric switches." J. G. Dixon. Dated July 12th, 1898. Consists in forming the contact making blade, with a V-shaped end and to this V end a suitable number of copper strips of the same formation are attached. The strips form the contact making brush, and when contact is made their ends bear against sliding terminal blocks which are adjustable by set screws. 2 claims.

16,602. "Improvements in drums for holding electric cables and in covers to be used with such drums." T. Oxley. Dated July 30th, 1898. Consists in forming the barrels and flanges of drums of steel or iron plate, and form covers to be used with drums of connected lags of wood or steel or iron, or corrugated steel or iron. 11 claims.

16,714. "Improvement in systems of electrical distribution." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated August 2nd, 1898. Relates to a system of electrical distribution, and comprises means by which it is possible to obtain polyphase currents for operating polyphase motors or other translating devices by interlinking a number of sources of alternating electro-motive forces in such a manner that a desired difference of phase is maintained between the different machines, which difference is staple. 17 claims.

19,936. "Improvements in controllers for electric motors." The British Thomson-Houston Company, Limited. Dated September 20th, 1898. Relates to controllers for electric motors. Four or more electric motors are combined. A switch is provided for each of the motors for operating them in pairs, in series, or in parallel, and for cutting in and out resistances in any desired manner, in affecting the change in speed or connection, and a cut-out switch for each motor. The contacts and connections are so arranged that when any of the cut-out switches are operated the remaining motors will be connected only in parallel, and be regulated by the resistance steps of the controller. 6 claims.

19,937. "Improvements in or relating to electric braking apparatus, adapted especially for use in electric tramways." The British Thomson-Houston Company, Limited. (J. B. Linn.) Dated September 20th, 1898. Relates to electric braking apparatus, and has for its object to provide a system of connections which will obviate the slipping of wheels which occur when the brake is applied with too great a force. This is done by connecting the armature of each motor to the field of the other in a two-motor equipment. By this arrangement when the brake shoe upon any axle checks the rotation of the axle too much, the motor upon the sticking axle ceases to generate current, and the field of the other motor is killed, the shoe is released when the axles begin to revolve. 4 claims.

19,938. "Improvements in safety devices for dynamo electric machines." The British Thomson-Houston Company, Limited. (E. M. Hewlett.) Dated September 20th, 1898. Relates to a speed governor and a circuit interruptor combined. The invention is described as being applied to a steam engine. As long as the steam engine is running below a certain maximum speed, the governor rotates without effecting the switch or the valve, but when the speed rises beyond the maximum desired, a pin strikes the adjusting screw in the end of a slot, pulls a bar and trips a latch; a weight then drops, cutting off steam from the engine, at the same time the switch blade is drawn across the contact closing the circuit of the shunt coil and opening the circuit braker. 6 claims.

19,939. "Improvements in safety devices for dynamo-electric machines." The British Thomson-Houston Company, Limited. (E. M. Hewlett.) Dated September 20th, 1898. The dynamos in connection with the driving engines are in the electric circuit. The engine governors are connected mechanically to the engine and electrically to a source or current, so that if the engine races the governor will operate the mechanism and automatically shut off the power supply, and cut out the dynamos from the circuit. 6 claims.

19,941. "Improvements in electrostatic measuring instruments." The British Thomson-Houston Company, Limited. (E. Thomson.) Dated September 20th, 1898. Relates to electrostatic measuring instruments designed to measure high potentials, in which the combination of a vibrating needle, vanes for moving the needle, stationary inductors acting upon the vanes, a scale plate over which the needle moves, a case surrounding the instrument having a glass covered opening and a wire screen electrically connected to the case located over the needle. 12 claims.

21,045. "Improved means for driving the speed indicators of electric motors." The British Thomson-Houston Company, Limited. (E. J. Berg.) Dated October 6th, 1898. Relates to apparatus whereby the drop in speed of an induction motor at the receiving station may be made known at the generating station. Use is made of the fact that currents are developed in the induced member of the motor of a frequency corresponding to the slip. By tapping the windings of the induced member at suitable intervals currents may be taken off of a frequency corresponding to the slip. If these currents be conducted to the generating station and the frequency of the currents there measured, a result is obtained indicative of the speed of the induction motor. 9 claims.

21,240. "An improved telephone call counter." F. M. Richter. Dated October 8th, 1898. Relates to telephone call counters. On inserting a connecting plug into a plug sleeve of the telephone switch double levers and a pallet are moved to operate the pallet mounted on a shaft to engage a pallet wheel, thereby turning the same half a tooth, whereas on removing the plug the double levers and pallet are returned to their initial positions, the broad tooth of the lever simultaneously completing the movement of and arresting the pallet wheel until the plug is again inserted. An arresting device is mounted on the shaft for preventing the registration of calls not effected. 2 claims.